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BUDDING RUBBER.

Keen interest is now being taken in the question of budding rubber in Ceylon. In our present number are reproduced the lecture given by the Curator of the Royal Botanic Gardens, Peradeniya, before the Sabaragamuwa Planters' Association and the report of the officer of the Department of Agriculture selected for training in Java.

It was only during last year that the possibilities of successful budding under Ceylon conditions were demonstrated and a small number of successes were secured in the nurseries of the Royal Botanic Gardens, Peradeniya and by MR. ROY BERTRAND upon an estate in the Kalutara district.

These successes have naturally led to further enquiries being made and many estates are now alive to the work that has been accomplished in Java and elsewhere, and are desirous of making trials upon their properties.

The Ceylon Rubber Research Scheme undertook to send a subordinate officer of the Department of Agriculture to Java for training in the art of budding rubber, and is also offering an award for the largest number of budded plants obtained by any estate before the end of the present year.

It has also been decided that the services of the trained officer should be loaned to estates for experimental trials under estate conditions. Several estates have already signified their desire to avail themselves of this opportunity.

During the month of May, buddings were carried out at the Botanic Gardens, Henaratgoda, from trees (Numbers 2, 39 and 439) known to be high yielders. The weather was dry particularly at the beginning of the month, but it is expected that

at least twenty-five successfully budded plants have been secured and that better results will have been obtained from the buddings made during the wetter days of the first part of June.

For estates, it is essential that they should have secured in the first instance reliable data as to those trees which are heavy yielders and that suitable nurseries have been established. Budding in nurseries appears to be preferable to direct budding in the field, although the latter may be quite successful under certain conditions.

Old estates with no available lands for new clearings cannot take advantage of the benefits which may accrue from areas of budded rubber. It has yet to be demonstrated that it would be a wise policy to cut out old rubber and to plant up new areas. The conditions under which such a procedure could be adopted with safety have yet to be demonstrated and it is quite possible that areas would have to remain for several years before being replanted if the dangers from diseases were to be avoided.

Estates with areas yet unplanted or with areas planted during the past two years should make experiments with budded rubber, and ascertain for themselves the increases in yields that can be secured by such a method. It is not suggested that large areas should be so dealt with at the beginning, for the yielding capacity of budded rubber has yet to be demonstrated.

Everything points, however, to budded rubber being capable of producing greatly increased yields over areas planted with a mixed population raised from seed. It is also possible that with the progress of time, competition between the various rubber-producing countries will become keener and those that are able to turn out their product at the lowest cost will find themselves in the most favourable position.

Now that estates have taken up the question seriously, it is expected that rapid progress will be made. Java, Sumatra and the Federated Malay States are all more advanced than Ceylon in this matter of the budding of rubber, but this should make it only the more important that its possibilities in this country should be fully tested.

RUBBER.

BUDDING OF RUBBER.

T. H. PARSONS, CURATOR, R.B.G., PERADENIYA.

Whilst the subject of this lecture* is primarily to give the results of experiments carried out to date at Peradeniya on Rubber Budding, it is perhaps advisable to firstly give some reason as to why this selective reproduction beyond the normal collecting and raising of seeds is necessary.

The object therefore of applying the respective forms of reproduction to Hevea are, briefly, to increase the yield of latex in conjunction with a healthy and strong tree. Of the respective forms of reproduction, seed selection and vegetative reproduction apply to Hevea, and vegetative reproduction can for the purpose of this lecture be confined to Budding.

Members here to-day do not need telling that plantations of Hevea consist of many bad yielders and few good ones, and that by propagation from normal seed, a young plantation will again consist of many bad and a few good yielders, and so on indefinitely.

The natural high yielders of an estate can be found on an examination of their latex rings, and for this purpose investigations in Java have been undertaken for ascertaining the number of latex rings in the young budded rubber and is summarised by DR. W. VISCHER in "Communications of the West Java Experiment Station" as being extremely favourable to the budded plants.

It is now necessary to emphasise most forcibly the importance of knowing the latex yielding capabilities of your mother trees, as a considerable time must necessarily elapse before reliable records can be obtained. This should be the preliminary stage of any experiments undertaken in regard to the required improvements mentioned above.

Experiments in Java on seed selection are already in hand, seed having been obtained and imported for breeding and hybridizing experiments, and in the direction of seed selection and thinning. The length of time required however to breed a tree such as Hevea true to type tends to rule this method out for present discussion here, though it must be remembered that seed selection should result in a most highly productive variety of tree after a constant form that breeds true to type has been isolated and established. As before mentioned, however, the time that this would take, probably the third or fourth generation, is not conducive to immediate results by any means.

The second means of reproduction therefore is by vegetative reproduction, and in the form of budding, which concerns us at the present moment more than seed selection, because of the fact that results are seen and obtained in a much shorter space of time and particularly in the fact that there appears a greater certainty of transmitting the qualities of the parent by means of this vegetative form of reproduction.

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* A lecture delivered by MR. T. H. PARSONS, Curator, Royal Botanic Gardens, Peradeniya, before a meeting of the Sabaragamuwa Planters' Association.

With regard to this DR. VISCHER in the article mentioned above concludes that the generative offspring of a single mother tree belongs to many different types, and the combined superior qualities of the mother tree re-appear only as a rare exception in the offspring. Vegetative offspring on the other hand belongs to a single type, and the peculiarities of the mother tree in all cases re-appear in spite of the stock and foreign roots on which the buds has been grafted.

The results which theoretically might be expected from this improvement in type of Hevea is sufficiently illustrated if we cast our minds back to what has been done in respect to other economic products when improvement of type either through seed selection, hybridization or by vegetative propagation has been undertaken.

Further, it is necessary to lay force on the fact of the impossibility of the present trees competing against an improved type such as this budded rubber is expected to be. An illustration of this is seen in the results obtained in Java on Cinchona where the planters doubled the production from the individual trees purely by careful and continuous selection.

Java has at the present moment some acres of budded Rubber now four years old. The buds were obtained from known heavy yielders, and on the theory mentioned above the vegetative offspring should be expected to reproduce the characters of its parent. Since however the product of Hevea is peculiar to itself, in the form of a latex yield, it is possible that the expected results may be somewhat modified. From investigations up to the present however it is noted there is sound reason to anticipate that budded rubber will result in all that is expected of it, and, if so, no estate can hope in the future years with the present type of Rubber to cope with this improved form of tree, and on this assumption it is obvious that the old estates who do not advance with the times must necessarily, slowly but surely, go to the wall.

The question as to the exact extent latex production is a hereditary character and also what relation may exist between the root of the stock and the budded scion in the eventual yield, should be definitely answered within a short time when the tapping records of the plants budded in Java in 1917 are obtained.

The actual operation of budding and its preparation can now be described. In the first case care should be taken to obtain seed for the stock seedlings from your healthiest and high yielding trees. These should be sown in nursery beds and later thinned out to approximately 18 in. apart. This will allow of accessibility when the budding operations commence.

The stock seedlings should be large enough for budding purposes at from 12 to 18 months old, therefore seeds sown in August-September should be ready in the following August to January which months have proved the most satisfactory months so far at Peradeniya for budding operations.

The materials required will be a sharp budding knife, budding tape, and grafting wax. Ordinary cotton cloth answers the purpose quite well and can be cut to various lengths or widths according to the size of the stock budded.

The grafting wax is composed of 1 part beeswax, 1 part tallow and 2 parts resin. The beeswax and tallow should be melted, adding the resin after it has been well powdered, and the whole stirred well. Soak the

budding tape or cloth in the mixture whilst it is hot and hang up to dry for an hour or so, afterwards winding the tape or cloth around a stick. The waxed tape will thus keep of suitable consistency for a long time.

Another preparation found to be satisfactory where tried in the more rainy districts is resin 4 lb., beeswax 1 lb. and enough linseed oil to work well.

Of the forms of budding, it is generally recognised that patch budding is preferable to Tee budding, a difficulty being experienced in the latter method in getting rid of the latex which exudes following the incision. Inverted Tee budding however has its advantages. A description of these methods are given below, quoted from the Rubber Research Scheme (Ceylon) circular and published in the TROPICAL AGRICULTURIST for December 1921 on the subject of BUDDING AND GRAFTING OF RUBBER.

The T and Inverted T method of budding :—

The method employed is to remove a piece of bark with bud required to be inserted into the stock and then to remove carefully the small portion of wood taken with the bark. In the bark of the stock into which the bud is to be inserted an incision in the form of a T in T budding, and the reverse in inverted Tee budding is made. The bark is then raised and the bud is gently pushed into the opening. It should be bound with waxed tape, leaving only the tip of the bud exposed. At Peradeniya it appears that complete covering of the inserted bud for a few days may be desirable.

Patch budding :—

"In this case a rectangular piece of bark containing a bud is transferred into the stem from which a similarly shaped piece of bark has been removed. A small quantity of grafting wax is then smeared over the edges of contact and the bark then tied firmly with budding tape or strands of bark. After this the whole should be covered with strips of cloth dipped in melted paraffin wax, as a further preventive against the admission of air and moisture. It is necessary that the bud should fit accurately the incision in the stock."

During and subsequent to the operation shady conditions are necessary.

It is necessary also to add that great care should be taken in removing the small portion of wood from the bud sheath as experience here has shown that unless great care is used the small bud will remain in the piece of wood discarded and an empty sheath is consequently put on the stock.

The budding should be made as near ground level as possible as shown in illustration. All cuts should be clean ones, and the operations should be carried out speedily and cleanly.

After 14 to 18 days the bandages can be removed. If the operation has been a successful one the bud and bud sheath will show a healthy green and similar to its appearance at time of budding. After the bandages have been removed for a week the stock can be cut to within 3 in. of the bud joint, which will result in all the vigour of the stock plant being forced into the newly attached bud.

The parent tree from which the buds are obtained must obviously be of those known to be heavy yielders, free from disease, and the healthiest possible, and the buds will be located invariably on the previous season's wood. The numbers of buds the parent tree will furnish will depend of course on the size and age of the tree.

A point to note is in regard to the fitting of the bud into the incision. It has to date been held that an accurate and tight fit of the bud sheath with the incision is essential. MR. NOLTHENIUS in a translation of a recent article on bud grafting of Rubber from the ARCHIEF VOOR DE RUBBERCULTUUR states that there is no need at all for the patch to fit exactly in the incision and that in Hevea budding the patch should be slightly smaller than the incision. The contention is that the main principle in budding or bud-grafting is to see that the cambium layers are in absolute contact, the bark union being a secondary matter. It also states that the advantage is that, if the bark of incision and patch do not fit exactly, that there is room for the latex to run away so that coagulating under the patch as soon as it is pressed tight with the bandage tape, is prevented. This may be so, and if such is the case, bud grafting is so much the easier. In fact MR. ROY BERTRAND mentions that he has had success with a discrepancy of not less than 1/8 of an inch between the edges of the bud sheath and the edge of the bark on the stock. It appears therefore that the difficulty and time taken in getting a close and tight fit can be eliminated.

The right degree of pressure to apply when binding up the inverted bud with the tape is difficult to estimate, as to bind too tightly will damage the delicate cambium, whilst to bind slackly or loosely would allow outside conditions to affect the bud and would not be waterproof.

Another point to note subsequent to the budding operation is that the buds are liable to become damaged by mud splashed up by the rain. In order to avoid this the ground under the plants should be covered with straw, dried grass or dried leaves.

The actual experiments in budding carried out at Peradeniya were commenced in 1920 on a limited number of stocks that were then available in the Nurseries, to ascertain the feasibility of the application of budding to Ceylon and to find out the best methods. For this purpose budding was tried at Peradeniya in July 1920 on 2-year-old plants in nursery beds. Dry weather followed soon afterwards, and efforts were made to keep the buds moist. At first they appeared to have formed a union with the stock, looking bright green and apparently putting out fresh growth, but they afterwards shrivelled up and died. The method adopted was the "Inverted T and Shield" the latter being taken with a fairly large allowance of bark. Experiments were again tried in 1921 and plants of 1½ years old Hevea in nursery beds were budded with fairly dormant buds in January on the T and inverted T system. These buddings were made low down on the stock, and looked well for the first week, but all the buds died within a fortnight.

On the next budding the heavy rains of 1·27 and ·90 respectively resulted in damage by soil splashing, the bud bandage being entirely coated with sand. It was decided henceforth to make the buddings higher than previously.

Regular buddings were undertaken during February, March, April, and May, the latter two months with more advanced buds, but in each case no successes were obtained. In the dry months of February and March all buds rapidly died off though larger shields were inserted with the buds with the object of allowing the bud to retain its vitality over a longer period.

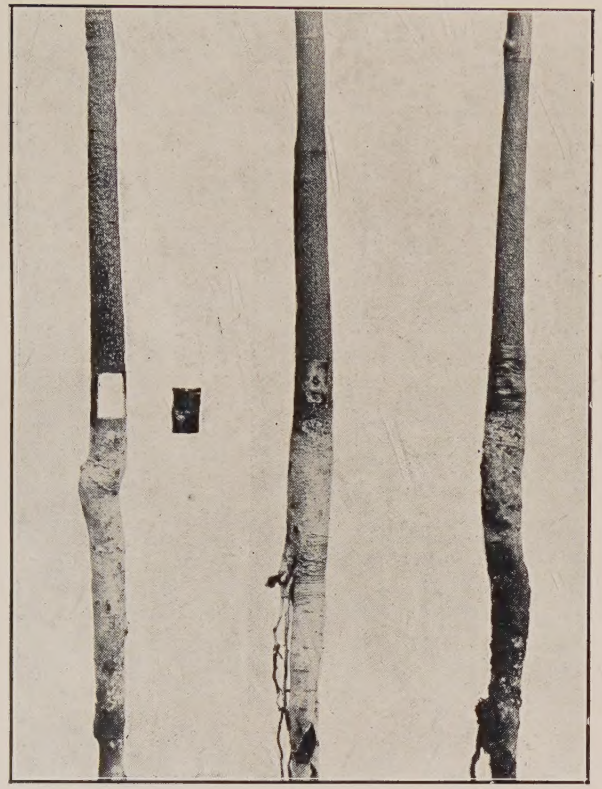

Fig. 1. YOUNG RUBBER STUMPS, SHOWING PATCH BUDDING.

Fig 2. GROWTH OF BUD.

Fig. 3. BUDDED RUBBER IN NURSERIES AT PERADENIYA.

The buddings of April with average size buds, when a few showers were experienced, survived for three weeks in a green state, but eventually died. The longer period these lasted was assumed to be due to the favourable conditions due to showers, and to a less dormant bud than previously being used.

With the failure of the May buddings however the T system was discarded and Patch Budding substituted during the following months. The result of this was that the bud and shield retained their vitality in each case for periods varying from 3 to 4½ weeks during the more favourable weather, but eventually dried up. On a careful inspection of the dried buds I found no sign of a junction with the cambium of the stock owing to latex having coagulated over the cambium surface of the stock. This was remedied in subsequent buddings by making the vertical incisions on the stock a short time prior to the removal of the section of bark.

The buddings undertaken on September 13th however (budded with moderate sized buds, still on patch system) have at last proved that the present system of budding is a correct one for Hevea. Of the twelve, six were successful, these buds beginning to show growth about the middle of November and at end of year had attained a bud growth varying from 18 in. to 30 in. The height at present varies from 6 ft. to 8 ft.

The two illustrations show the September buddings at 7 months from time of budding and the junction of stock and bud at 7 months old.

I would add that successful budding of Hevea has also been accomplished by MR. ROY BERTRAND at Neboda to whom I am indebted for assistance in a comparison of our respective operations enabling me to arrive at more definite opinion than otherwise would have been the case.

In conclusion I would quote a portion of a paper given to the Kajan District Planters' Association in Malaya recently by MAJOR GAUGH on the effect budding is likely to have on the Industry. He states : "As regards the effect bud-grafting will have on the rubber industry if it is the success that is thought certain, a trebled and quadrupled yield might make people wonder how the rubber will be absorbed. I do not believe there is any reason for panic. It is no use bud-grafting grown trees, and if you fell old trees and replant, the growth of the young trees will be very poor on most washed-out soils of the average rubber estate. What is left, therefore, for old established companies to do? They should certainly, first of all, bud any newly planted clearings which they are lucky enough to possess, before the trees grow too large and then they should turn their attention to their reserve jungle and open it up for bud-grafting. If they have neither young clearings nor jungle, they had better begin to look about and see if they cannot get jungle ear-marked for them against the day when the Government again grants or sells lands. No estate can hope to be still prosperous eight years hence, with only ordinary rubber if competing against Dutch and other estates with areas producing rubber at perhaps *3d.* per lb., but an estate with an appreciable area of budded rubber could tap that at a good profit and, at the same time, could devise schemes for extracting high yields of rubber at a profit by intensive tapping of divided up areas of their ordinary rubber, in rotation. In some such manner all estates might continue to show a good profit indefinitely."

NOTES ON BUDDING OF RUBBER IN JAVA.

T. V. THAMOTHARAM.

Budding is carried on in a very extensive scale in Java with great success. The process of budding is simple but a great deal of care is essential.

Grafting is not carried on in rubber as it has not proved a success.

The following points should be carefully observed in budding rubber :—

(1) *The Budding Knife.*—The knife should be very sharp and pointed. It should be made of steel of good quality and should be kept free from rust.

(2) *Best Time for Budding.*—In Java budding is carried on during the rainy season, *i.e.*, between January and May. It is best to carry on budding during the rainy season. During this period the bark peels off easily and the scion grows into the stock rapidly.

(3) *Stocks used for Budding.*—The stocks should be between 1—2 years of age and they should be free from disease.

(4) *Which Buds to Use.*—The buds must be removed from trees which are known to be high yielders. The scion also, like the stock, should be healthy and free from disease.

THE DIFFERENT METHODS OF BUDDING.

The following are the three well known methods :—(a) Pluk or Patch, (b) Deli, (c) Forkert.

Pluk or Patch budding

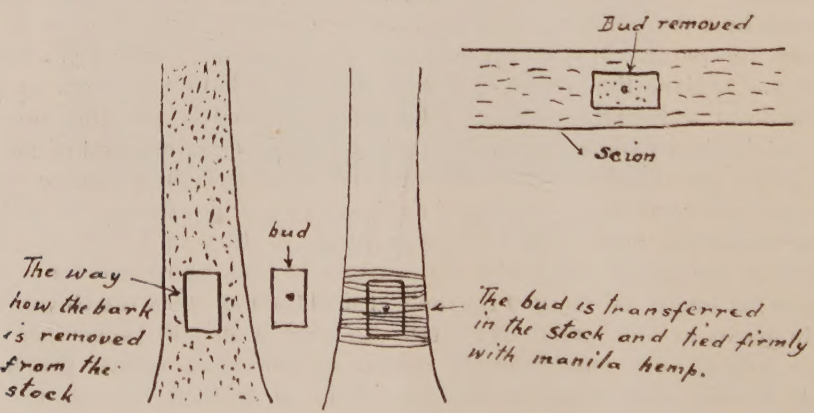

FIG. 1.

The bud must be removed with a small piece of bark adhering to it. A piece of bark of the same size is then removed from the stock and the bud

transferred to it. This should then be well bandaged with Manila hemp. Special precautions must be taken not to damage the bud during the operation. The bud should be shaded from the sun and the bandage air-tight.

Deli Method.

FIG. 2.

In this method the bud is shaved up with a clean cut and an incision as shown in the diagram is then made in the stock and the bud inserted in it. The whole area is then firmly tied up with a bandage without leaving any portion of the bud exposed.

Forkert Method :

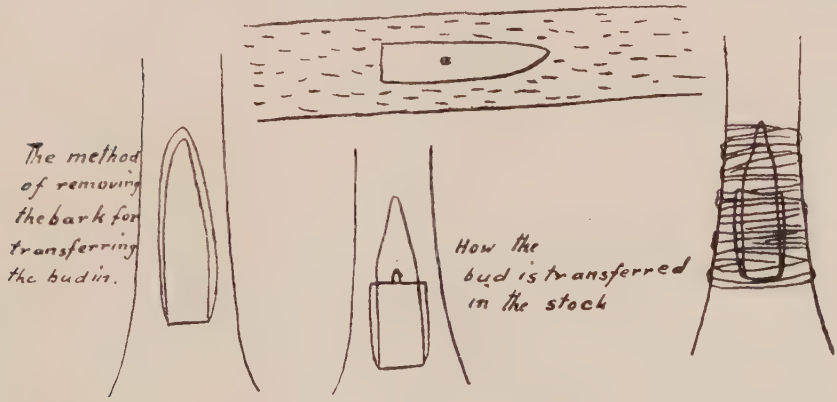

FIG. 3.

In this method the bud is removed with a downward stroke of the budding knife. The bud is inserted as in Deli method and covered up with a portion of the bark of the stem as shown in the diagram. It is then tied up with manila hemp.

AFTER TREATMENT OF BUDS.

After 15 days or so the bandage is removed and if it is found that the bud is green we can be sure that the operation has been successful. After one month of budding if the budded portion is still found to be green then the stock is cut off leaving about 2 inches above the budded part. The cut is then tarred. Some buds grow rapidly but others take a long time to shoot. When the bud shows signs of healthy growth then the stock is ready for planting in the field.

GOOTEE-LAYERING OF BUDDED PLANTS.

This is called in Java "Marcoting." The Manager, Experiment Station, told me that budded plants may not be true to type because the roots of the plant belong to one parent and the stem and branches to another. In this case a good variety is introduced into a bad variety. There may be some effect of the latter upon the former. In order to make it entirely pure the budded plant is "marcotted" two years after budding. The "marcotted" plant is then similar to its parent in its yielding capacity.

The Method of Gootee-layering :—The bark is usually removed round the branch for nearly an inch in length below a node. After the removal of the bark the cambium too should be removed with the aid of the budding-knife. This should be done without injurying the wood. The portion from which the bark was removed is then covered up with clayey soil. This is, in turn,

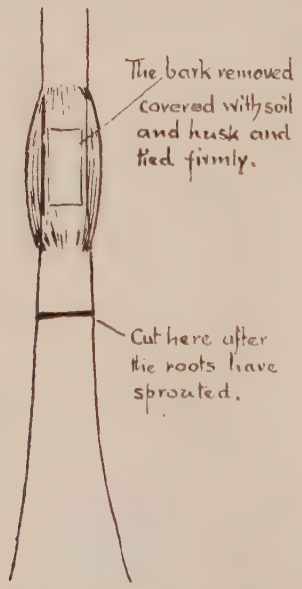

FIG. 4.

covered with well prepared coconut fibre and dust and carefully tied up with thin strips of bamboo. After about four to six months roots will be noticed piercing through the bandage. The branch should now be cut off and transferred to a basket. It should be planted in the field one month after being transferred to the basket.

COCONUTS.

CHILAW COCONUT EXPERIMENTS.

The figures for these manurial experiments have been supplied to members and the actual position was shown in the graph exhibited at the meeting.

All plots show increased yields of nuts, more particularly those on the lighter land.

The most marked increase in number of nuts per palm is shown by plot No 8 which receives applications of lime and this plot gave yields in excess of its previous highest record in 1918. Plot No. 9 securing the Organic mixtures also showed good increases and now gives second largest yield. Plot 15 which has received lime in 1919 and 1920 has also shown good increases in crops since this application. Plot 13 securing the Organic mixture shows improvement. Plot 4 securing Steamed bone meal, has been the most steady of all plots and showed the effect of drought less than other plots.

The copra yields per palm and the number of nuts per candy of copra are also circulated. They have been put into graph form and the amount of copra per palm has been calculated.

If this graph is analysed the following results are found.

Plot 1. Number of nuts per palm improved during 1918 but then fell heavily owing to the shortness of rainfall. The copra per palm followed the course of number of nuts per palm.

Plot 2. The fall in 1918 was not considerable but the nuts were smaller. The copra yield per palm therefore fell more than the average. The improvement in 1920 was slower than the average but the recovery in the copra per palm was normal and these nuts increased in size with the improvement of the rainfall.

Plot 3. This is one of the steady plots and was not greatly affected by climatic conditions. The recovery after drought was fairly good. The number of nuts per candy fell somewhat considerably in 1918, but subsequently the position improved.

Plot 4. The best plot of the series and not so seriously affected by drought as the other plots. Recovery after drought good. Nuts above average size.

Plot 5. Fell rapidly in 1918 but recovery after 1919 was normal.

Plot 6. This plot was given uniformly satisfactory results. The size of nuts has improved and consequently the amount of copra per palm in 1921 was greater than in 1917.

Plot 7. This plot fell rapidly but just as rapidly recovered. The size of nuts was seriously affected by drought but they improved in 1920.

Plot 8. Nuts per palm greatly increased but size of nuts poor. The increased copra outturn is due to increase in the number of nuts.

Plot 9. The increased copra outturn in 1921 was due to improvement both in number of nuts per palm and to increase in size of nuts.

Plot 10. Rapid fall in 1918 and 1919 but just as rapid recovery. Effects of droughts clearly shown. Size of nuts fell greatly in dry weather.

Plot 11. Similar to 10 but better improvement in 1921 doubtless due to cultivation in 1920 and 1921. Good increase in number of nuts per palm.

Plot 12. Similar to 10 and 11. Increase in number of nuts per palm satisfactory after drought but fall in size of nuts during drought with improvement in 1920.

Plot 13. Rapid fall and just as rapid recovery. Number of nuts improved but size did not improve after 1920.

Plot 14. The number of nuts per palm steady. Size of nuts did not fall as much as in other plots, but there was a serious fall in the size of nuts in 1921.

Plot 15. Rapid fall and subsequently a very rapid rise brought out by the increase in the number of nuts per palm.

In general it may be concluded that crops of coconuts are largely dependent upon the rainfall of the previous 18 months. If there is a shortage of rainfall there is a rapid fall of crop. The size of nuts also varies with the rainfall. Ploughing and harrowing help very considerably during a dry period to maintain crops. The number of nuts harvested are maintained but the size is not improved and shows but little variation from plots where no cultivation was carried on.

Applications of Lime, both on heavy land and upon the lighter soil, have given markedly increased crops. The size of the nuts is however poor and therefore copra output is not so great as would be expected from the crops of nuts.

Steamed bone meal appears to be responsible for steadily maintained crops and for the maintenance in the size of the nuts. In general however the size of nuts is improved only by the application of Nitrogen. Organic nitrogen appears to be preferable but plot 6 which has received Sulphate of ammonia has also shown improvement. Mineral manures appear to possess greater residual effects than Organic manures.

F. A. STOCKDALE,

Director of Agriculture.

27th April, 1922.

CHILAW COCONUT TRIAL GROUND: DETAILS OF TREATMENT, 1915-1920.

No. of Field.	Treatment.
1.	Clean weeding
2.	Sulphate of Ammonia 2½ lb. per palm in 1915. Disc harrowed monthly 1916 and 1917 ,, ,, 10 times 1918 and 1919 ,, ,, 7 times 1920 and 1921.
3.	Groundnut cake 6 lb. per palm 1915, Crushed fish 6 lb. per palm in 1916, 1917, 1918, 1919 and 1920.
4.	Steamed bone meal 8 lb. per palm in 1915, 1916, 1917, 1918, 1919 and 1920.
5.	Sulphate of Potash 2¾ lb. per palm in 1915, 1916, 1917, Mendis Potash 5 lb. per palm 1918, 1919. Sulphate of Potash 3 lb. 1920.
6.	Ammonia sulphate 4 lb. per palm in 1915, 1916 and 1917, Mendis Potash 5 lb. per palm 1918. Sulphate of Ammonia 4 lb. per palm in 1919, 1920.
7.	Mineral mixture 6 lb. per palm in 1915, 1916, 1917. Mineral mixture 7 lb. 2 oz. per palm in 1918, 1919. Mineral mixture 6 lb. in 1920.
8.	Lime 10 tons per acre 1915, 1916 and 1917. Lime ½ ton in 1918, 1919 and 1920. Harrowed 7 times in 1921.
9.	Mixed manure 10 lb. per palm in 1915, 1916, 1917. Organic mixture 12 lb. 4 oz. per palm in 1918 and 1919, 10 lb. 2 oz. in 1920.
10.	Mulched with husks in 1915. No treatment subsequently beyond clean weeding around trees.
11.	Mulched with husks in rings round palms. Dug in 1920.
12.	Ploughed and disced. Harrowed 7 times in 1921.
13.	Ploughed and disced. Mixed manure 1917. Organic mixture 12 lb 4 oz. per palm 1918, 1919. 10 lb. 2 oz. in 1920. Harrowed 8 times in 1921.
14.	Dug with mamoty and mulched with leaves. From 1919 mulch removed and plot harrowed in 1919 10 times, and 7 times in 1920 and 1921 respectively.
15.	Watered. Watering stopped in 1919 and lime applied at the rate of ½ ton per plot, similar applications made in 1920. Harrowed 7 times in 1921.
16.	No treatment, Store, etc.

TABLE I.

Statement of yields of the Chilaw Coconut Trial Ground.

Plot.	Number of Palms	1915		1916		1917		1918		1919		1920		No. of palms	1921	
		Yields	Yields per palm	Yields	Yields per palm	Yields	Yields per palm	Yields	Yields per palm	Yields	Yields per palm	Yields	Yields per palm		Yields	Yields per palm
1	47	1931	41·1	2677	57·0	3262	69·2	3550	75·5	2428	51·6	2504	53·1	47	2917	62·1
2	72	2804	38·9	4010	66·8	5267	73·1	5082	70·6	4060	56·4	4061	56·4	71	4787	67·4
3	89	3581	40·2	5014	56·3	5217	58·6	5127	58·7	4404	49·6	4811	54·1	89	4916	55·2
4	81	4429	54·7	5800	71·6	5648	69·7	5993	74·0	4885	60·3	5244	64·7	80	5562	69·5
5	84	3542	42·2	5225	62·2	5690	67·7	4848	57·9	3894	46·3	4945	58·9	87	5464	62·8
6	78	3829	49·0	4074	52·2	5114	65·5	5094	65·3	4041	51·8	5153	66·1	78	5295	67·9
7	92	3304	35·9	4714	51·2	5585	60·7	5392	58·6	4066	44·2	5084	55·2	90	6258	69·5
8	68	2674	39·3	3306	48·6	4057	59·6	4903	72·1	3251	47·8	3378	49·7	64	4813	75·2
9	85	3383	39·8	4499	52·9	5464	64·2	5098	59·9	3586	42·2	4483	52·7	86	6058	70·5
10	107	2933	27·4	4616	43·1	4576	42·7	3034	28·2	2019	18·9	3307	30·9	101	4407	43·6
11	100	2861	28·6	4286	42·9	3713	37·1	2271	22·7	1579	15·8	3091	30·9	97	5048	52·0
12	101	2936	29·1	4691	46·4	3772	37·3	3375	33·4	2109	20·9	3628	35·9	97	4481	46·2
13	99	1859	18·7	3694	37·3	3384	34·1	3232	32·6	2045	20·6	4195	42·4	99	5148	52·0
14	46	2338	18·4	2294	50·0	2054	44·6	1918	47·7	1370	29·8	1868	40·6	52	2370	45·6
15	81	—	—	3087	38·1	2094	25·8	2026	25·0	1341	16·5	2512	31·0	76	4153	54·7
16	59	2373	40·2	3222	54·6	3055	51·7	3154	53·4	2841	48·1	2730	46·3	62	3204	51·6
Rainfall		-	53·33 in.		64·69 in.		41·66 in.		51·78 in.		54·99 in.		69·50 in.			44·68 in.
Wet days		-	86		88		75		76		100		95			78

CHILAW COCONUT EXPERIMENTS.

Copra Figures.—Table II.

Plot	1917. Copra per palm lb.	1918. Copra per palm lb.	1919. Copra per palm lb.	1920. Copra per palm lb.	1921. Copra per palm lb.
1	27·0	27·9	16·6	20·2	25·7
2	32·6	24·4	19·0	22·8	28·4
3	30·1	24·6	19·9	24·5	27·7
4	35·8	32·6	25·1	31·1	34·9
5	32·6	23·8	18·0	26·7	29·7
6	28·7	24·5	19·0	28·6	31·4
7	25·1	20·1	14·5	23·0	28·8
8	22·3	21·2	13·3	18·4	27·6
9	24·2	17·7	12·4	20·4	28·3
10	16·8	8·0	5·7	11·8	17·8
11	16·0	7·5	5·2	13·6	22·0
12	15·5	10·4	5·9	14·4	18·5
13	14·5	10·2	6·2	15·8	19·9
14	17·6	12·9	9·8	15·0	16·1
15	10·1	8·1	4·6	13·3	21·1
16	19·0	16·7	14·5	18·0	21·8

CHILAW COCONUT EXPERIMENTS.

Copra Figures—Table III.

Number of nuts per candy of Copra.					
Plot.	1917	1918	1919	1920	1921
1	1379	1491	1694	1429	1330
2	1231	1590	1613	1353	1293
3	1065	1269	1346	1199	1096
4	1055	1237	1294	1126	1083
5	1139	1310	1402	1179	1163
6	1228	1454	1472	1261	1183
7	1317	1559	1660	1316	1333
8	1467	1863	1972	1484	1495
9	1456	1839	1847	1429	1364
10	1399	1922	1787	1406	1333
11	1265	1626	1620	1240	1285
12	1299	1721	1902	1359	1355
13	1297	1728	1752	1434	1410
14	1381	1745	1641	1446	1533
15	1386	1660	1947	1262	1412
16	1464	1640	1767	1378	1293

MANNING COCONUT TRIAL

REPORT FROM

The following report upon these experiments has

The experiment was started on the 15th of February 1917 to determine its products be returned to it. The fallings including the leaves, husks, water, that is removed from it.

PRODUCTS OF

Year.	Number of bunche in the 35 trees.	Number of fallen branch-es.	Weight of the fallen branch-es. lbs.	Weight of other fallings lbs.	Number of nuts from the 35 trees	Weight of the Green nuts. lbs.	Weight of the same nuts. after 2 Mon-ths. lbs.	Weight of the husks of the nuts after 2 Mon-ths. lbs	Weight of water in the nuts on the opening day. lbs.	Weight of kernel and shells of the nuts. lbs.	Weight of the shells. lbs.	Weight of copra produc-ed by the 35 trees. lbs.
1917	406	410	2644	759	2165	7935	5903	2728	577	2674	743	1015
1918	404	500	2145	776	2164	7663	5655	2797	485	2364	745	943
1919	367	477	2015	575	2068	7511	5801	2926	510	2383	745	919
1920	368	551	2007	540	2052	7311	5587	2904	378	2313	725	910
1921	360	493	1981	515	2047	6659	4678	1951	290	2245	706	912

PRODUCTS

Products returned.	Total weight of products returned to the soil in 1917.					Total weight of products returned to the soil in 1918				
	lb.	Ton	cwt.	qrs.	lb.	lb.	Ton.	cwt.	qrs.	lb.
Branches	2644	1	3	2	12	2145	0	19	0	17
Other fallings	759	0	6	3	3	776	0	6	3	20
Husks	2728	1	4	1	12	2797	1	4	3	25
Water	577	0	5	0	17	485	0	4	1	9
Shells	743	0	6	2	15	745	0	6	2	17
Poonac	338	0	3	0	2	314	0	2	3	6
Total weight of products returned to the soil	7789	3	9	2	5	7262	3	4	3	19

Total weight of products produced by the 35 trees.

	Tons.	cwt.	qrs.	lb
In 1917	3	15	2	12
,, 1918	3	10	1	24
,, 1919	3	8	2	17
,, 1920	3	6	2	16
,, 1921	2	16	2	27

GROUND, NEGOMBO.

1917 to 1921.

been supplied by Gate Mudaliyar A. E. Rajapakse :—

if the fertility of a coconut land and its productivity could be maintained if shells and poonac are returned to it once a year and oil is the only product

THE SOIL.

Weight of poonac	Weight of oil removed	Average nuts per tree	Largest annual crop of a tree.	Smallest annual crop of a tree.	Largest quantity of copra produced by a tree.		Smallest quantity of copra produced by a tree.		Annual Rainfall.
lbs.	lbs.				lb.	oz.	lb.	oz.	Inches.
338	677	61·8	94	23	41	13	11	10	71·58
314	629	61·7	112	20	51	13	9	4	61·50
306	613	59·8	112	15	33	2	7	12	80·36
303	607	58·6	86	5	30	5	2	13	80·22
304	608	58·5	84	20	37	4	7	7	51·47

RETURNED.

Total weight of products returned to the soil in 1919.					Total weight of products returned to the soil in 1920.					Total weight of products returned to the soil in 1921.				
lb.	Ton.	cwt.	qrs.	lb,	lb.	Ton.	cwt.	qrs.	lb.	lb.	Ton.	cwt.	qrs.	lb.
2015	0	17	3	27	2007	0	17	3	19	1981	0	17	2	21
575	0	5	0	15	540	0	4	3	8	515	0	4	2	11
2926	1	6	0	14	2904	1	5	3	20	1951	0	17	1	19
510	0	4	2	6	378	0	3	1	14	290	0	2	2	10
745	0	6	2	17	725	0	6	1	25	706	0	6	1	6
306	0	2	2	26	303	0	2	2	23	304	0	2	2	24
7077	3	3	0	21	6857	3	1	0	25	5747	2	11	1	7

MANNING COCONUT TRIAL

FROM 1st MAY 1921

The following report has been supplied

The plots were organized in May 1921 each acre plot being divided manurial treatment is continued to determine definitely what proportion of crops of the individual plots are separately recorded and also the quantities

A denotes good soil — *B* denotes very

Number of the Plot	1922 (April 30th) A census of the Palms				Bimonthly Crops						Total annual crop
	In bearing	In Flower	About to flower	Young	June Crop	August Crop	October crop	December crop	February crop	April crop	
No. 1 A	24	6	5	—	91	91	75	27	22	67	373
1 B	8	11	16	—	12	10	9	2	7	10	50
No. 2 A	30	—	2	3	171	238	182	59	76	96	822
2 B	9	6	19	1	49	38	44	14	10	19	174
No. 3 A	23	2	8	2	194	155	97	59	49	96	650
3 B	13	11	11	—	97	53	50	18	10	24	252
No. 4 A	22	7	5	—	50	28	22	28	19	52	199
4 B	12	9	9	5	23	16	12	3	11	19	84
No. 5 A	25	6	3	1	103	69	72	47	36	65	392
5 B	15	3	14	3	53	23	42	13	11	17	159
No. 6 A	18	7	9	1	99	68	59	29	55	82	392
6 B	18	6	7	4	78	43	40	33	25	29	248
No. 7 A	25	4	2	4	182	115	61	33	63	95	549
7 B	17	5	7	6	28	22	27	23	15	14	129
No. 8 A	8	6	17	4	16	14	23	7	20	13	93
8 B	8	2	18	15	—	—	—	—	—	—	—
No. 9 A	19	4	9	3	97	66	47	37	43	68	358
9 B	1	3	24	7	—	—	—	1	6	—	7
No. 10 A	19	6	10	—	93	72	65	45	54	86	415
10 B	2	5	24	4	—	—	—		—	—	—
No. 11 *	33	2	—	—	331	242	145	71	96	213	1,098
No. 12 †	24	7	3	1	73	76	58	28	50	75	360

* Plot 11 is mulched with coconut husks after manuring.

GROUND, NEGOMBO.

to 1st MAY, 1922.

by Gate Mudaliyar A. E. Rajapakse :—

into half acre plots separating the good soil from the poor soil and the same Nitrogen, Phosphoric acid and Potash is requisite for nut production. The of manure applied to them annually.

poor sand without any organic matter.

Manurial compost applied													Number of times ploughed	Average annual crop per bearing trees.
Ground nut cake. lb.	Bone meal lb.	Sulphate of Potash lb.	Degel bone Meal lb.	Ammonium Sulphate lb.	Con. Super Phosphate lb.	Potassium Nitrate lb.	Sodium Nitrate lb.	Basic slag lb.	Nitrolim lb.	Kainit lb.	Lime lb.	Fish manure		
180	69	30	—	—	—	—	—	—	—	—	—	—	Once	15·5
180	69	30	—	—	—	—	—	—	—	—	—	—	do	6
—	—	30	50	—	—	—	—	—	—	—	—	—	do	27·4
—	—	30	50	—	—	—	—	—	—	—	—	—	do	18
214	—	30	—	—	—	—	—	—	—	—	—	—	do	28·2
214	—	30	—	—	—	—	—	—	—	—	—	—	do	19
207	—	—	50	—	—	—	—	—	—	—	—	—	do	9·04
207	—	—	50	—	—	—	—	—	—	—	—	—	do	7
—	—	—	—	—	—	—	—	—	—	—	—	—	Monthly	15·7
—	—	—	—	—	—	—	—	—	—	—	—	—	do	10
—	—	30	—	—	—	—	—	75	84	—	—	—	Once	22
—	—	30	—	—	—	—	—	75	84	—	—	—	do	13
—	—	—	—	75	36	—	—	—	—	125	—	—	do	22
—	—	—	—	75	36	—	—	—	—	125	—	—	do	7
—	—	—	—	—	—	—	—	—	—	—	—	—	Not worked	11·6
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	15	43	74	—	—	—	—	—	Once	18·8
—	—	—	—	—	15	43	74	—	—	—	—	—	do	7
—	—	30	—	—	—	—	—	75	84	—	111	—	do	21·8
—	—	30	—	—	—	—	—	75	84	—	111	—	do	—
180	69	30	—	—	—	—	—	—	—	—	—	—	do	33·2
180	69	30	—	—	—	—	—	—	—	—	—	—	do	15

† Plot 12 is mulched with fibre dust after manuring. Rainfall 51·47 inches.

COFFEE.

THE PREPARATION OF MYSORE COFFEE FOR THE ENGLISH MARKET.

The following is a prècis of valuable information contained in a pamphlet entitled " The Preparation of Mysore Coffee for the English Market " which has recently been published by MR. E. W. RUTHERFORD.

In the coffee bean there is no exact standard of quality but the buyer requires uniformity, evenness of colour and absence of faulty beans.

The structure of a ripe coffee berry (" cherry ") is as follows:—(1) An outer coloured skin, (2) a thin light coloured layer of fruity matter, (3) a network of slender filaments, (4) a gummy substance resembling mucilage after fermentation, (5) the " Parchment," (6) a pellicle called the silver skin, (7) two semi-elliptic seeds or one elliptic seed (" Peaberry ").

Quality depends largely on the proportion of sugar, gum and pectin to free acid and the proportion of soluble to insoluble matter.

During ripening saccharine matter is formed and free acid diminishes; a light rainfall and plenty of sunshine and air give favourable conditions for this process and will result in a good quality berry.

Picking.—Only mature fruit must be picked. In mature fruit the outer skin will be cherry red with perhaps a shade of golden colour but no green, the berry will come off its stem easily and on applying a slight pressure the seed will shoot out easily from the skin. Unripe fruit if present must be picked out when the fruit is measured and not allowed into the vat.

Pulping.—Pulping should be done as soon as possible to prevent possibility of fermenting which causes a discoloured bean known as " Foxy " coffee.

If a batch of coffee has unavoidably turned " Foxy " it should be kept separate from other coffee.

The setting of the pulper should be watched as cutting, pricking or rubbing of the beans may spoil a sample.

Fermenting.—After pulping, the gummy matter surrounding the parchment should be allowed to ferment to enable it to be removed in a soluble condition by washing. Fermentation must not be carried so far as to affect the parchment or the bean itself. The parchment is fermented in vats covered with old coconut matting for from 18 to 36 hours. Very ripe fruit, warm or rainy weather and a warm vat hasten fermentation while the opposite conditions retard the process.

Washing.—When on rubbing in the hands the glucose comes away easily, leaving a clean parchment the coffee is ready for washing. To facilitate washing the coffee should be trampled into a sticky mass in the vat before water is let in. Water should be clean and if slightly sun warmed washing will be expedited. While washing all light beans which float should be removed. Badly washed parchment may start fermenting again and so turn the bean acid besides picking up much dust which it is impossible to remove afterwards.

Drying.—After washing, the coffee is first put to drain on raised barbecues. It should be spread evenly and fairly thicky, continually turned over to avoid heating and left till all surface moisture has evaporated, but no longer.

The parchment is then removed to the ground where it is evenly spread an inch or so thick and continually turned to get a uniform drying. Fairly thick spreading results in slow drying which allows the colour of the beans to gradually develop. Thin spreading is likely to cause uneven drying. At a later stage when a hand rubbed sample shows a "damp slate blue" colour drying may be accelerated till the parchment weighs 32 to 33 lb. to the bushel when though still containing a little moisture it will be ready for despatch to the coast. Over-drying only bleaches the colours. Coffee is very hygroscopic and contact with moisture during the early stage of drying must be avoided. If covered with mats as a protection from damp care must be taken that heat is not developed under them.

Bulking and Sacking.—Any lots which are not in the same state of dryness should be sacked and despatched separately. Dry parchment should be kept in a heap and continually turned over till ready for sacking.

The following written in 1910 is a resumé of an enquiry made after a great outcry from Home Brokers and buyers in 1903 that the bulk of the East Indian coffee had deteriorated. The enquiry was undertaken by the writer for the purpose of obtaining samples of his proprietor's coffee during its preparation at Mangalore and discovering what influence if any the coast curing had on the colour of the beans.

The instructions were to take hand-rubbed samples as a criterion and prove by—

(1) A sample taken on arrival of carts in Manglore:— "If coffee deteriorates on the way down."

(2) A sample after drying in Mangalore:— "If the drying causes loss of colour."

(3) A sample after the coffee had passed through the mill:— "If the milling does any harm."

(1) *The journey from the estate to Mangalore.*— It was found that under normal conditions no deterioration of colour took place on the journey down up to the period of redrying. Damp and fermentation are the only dangers. In badly covered carts there is some danger from rain and dripping and at the river crossings some cartmen drive through the river to avoid paying ferry fees. If coffee is sent down in a very damp state it may ferment in the sacks.

On arrival in Mangalore cartmen go straight to the works and deliver their pass. The sacks are counted, the seals examined and the carters pour the contents in bushels. The bushels are then struck and counted by the firm's men and the contents emptied into sacks which are weighed to obtain the average weight per bushel on arrival. The following particulars are now entered in the books:—

Waybill No., Estate name, Bushels according to Planter, Bushels as measured in Mangalore, Date of despatch from Estate and receipt on Coast, Average weight per bushel, Condition.

A card containing these particulars follow the coffee through all further stages. Parchment is sometimes sent down from estates at weights varying from the weight soon after removal from the washing vats down to 28 lb. per bushel. Damp coffee often ferments in the bags and causes much trouble to the curers while, if the coffee is over-dry, the parchment may crack and the bean turn pale. A mixture of lots at different stages of dryness means uneven drying on the coast. 32 to 33 lb. per bushel is the best weight.

(2) *The Re-drying on the Coast.*—All coffee on arrival at the coast contains a certain amount of moisture. While this moisture is present the colour cannot be fixed and it is useless to compare estate hand-rubbed samples with samples after drying on the coast. The London market wants blue but perfectly dry coffee. Colour changes from a state at vat weight to bluish grey at 35 lb. After this it assumes a mottled appearance and when quite dry the colour is fixed at a blue green to slatey green. An inferior colour to start with ends in a pale grey. The coffee is shot out on to drying grounds as soon as practicable after its receipt and turned over continually. A damp coffee may take several hours or even days to dry while one nearly dry on arrival may need only $\frac{1}{4}$ to $\frac{1}{2}$ hour. This re-drying is continued till the parchment is hard and crisp and the coffee a safe weight for peeling. If milled too damp the parchment and silver skin would be ingrained into the bean by friction. A dry bean should crack like a nut between the teeth. When the horny part is hardened and the germ destroyed by the sunning the colour should be fixed.

Different coffees have different optimum weights for milling. The curer endeavours to stop the drying as soon as all moisture is driven off. Drying under mats produces uneven results and is to be deprecated. Small lots despatched soon after estate drying arrive in better condition than large ones which have been kept after drying to make up a big batch. With regard to colour probably the order of selling colours would be (1) Bluish green, (2) Greenish, (3) Slatey green, (4) Greyish green, (5) Greyish, (6) Pale in direct sunlight but grey in ordinary sunlight.

Numbers 1 to 4 would probably liquor better than (5) but would not necessarily roast better.

In bold coffees the "suture" or line down the centre of the bean is nearly or quite straight, in others it is not so. Bold fine, medium, round, flat, long beans and peas have a straight line if among colours 1 to 4 but not in the case of colours 5 or 6 in which case the beans will be slightly concave and malformed.

Reports from Home on samples of coffee taken during the process of re-drying on the coast indicated clearly that if dried thoroughly and evenly on the estate no deterioration of colour or quality resulted from a few days' detention on the coast and the sunning necessary to prepare the beans for milling.

After drying coffee is re-weighed and then stored to allow to cool before milling.

The Milling.—The "Edge Runner" peeler is now generally in use and consists of a circular through ridged down the sides, two peeling rollers with ridges up their sides and on their faces swung on a cross beam which revolves. Two sweepers follow the rollers. When the rollers meet the coffee they are caused to rotate in addition on their own axis. The trough will contain 18 to 20 bushels of parchment which takes about 10 minutes to peel.

Coffee should be quite dry for peeling, if damp it will deteriorate after milling. After a few revolutions of the rollers the trough is filled with a compost of parchment and silver skins which acts as a kind of protective

cushion for the beans. A parchment that has not been "crisped" or a dirty parchment is bound to cause discolouration. All coffee loses some colour during milling. In the case of uneven drying the loss is greater on the beans which contain moisture. It would appear that the rollers remove the outer parchment by friction and not by pressure. A faint white line round the edge of the bean after milling indicates either insufficient drying of the coffee or faulty setting of the peeler. Such beans always turn pale.

It has been proved that moist sea air is harmful to coffee after milling though storage during the season of land winds improves it.

Reports from Home on samples taken after milling proved that loss of colour always followed milling especially if the coffee was unevenly dried.

Winnowing and Sizeing.—The beans are carried from the peeling pit by travelling carriers to the winnower where dust and chaff are removed by a fan. Thence it passes to the sizers which consist of meshed cylinders which revolve and let each class of bean pass into different compartments.

The sizer classes the beans according to their width, thickness and afterwards according to flatness or roundness. Sometimes an extra separator is subsequently used which classes the beans according to their length. Another subsidiary machine is the Pea berry separator which separates out the "Peas."

Garbling.—This consists in picking out all "broken," "foxy," "black," "pale," "withered," "pulper-damaged," "pricked," "cut," "rubbed," and "coated" beans. Coated beans are those with the silver skin attached to them and generally result from leaf disease, picking when unripe or bad fermenting.

The coffee is now ready for shipping and is carefully weighed into sacks. The "Outturn of clean coffee" is now available.

A good outturn does not necessarily mean good prices, much depends on the moisture present when received by the curer.

SUMMARY.

1. Good cultivation and liberal bulk manuring produce good quality coffee.
2. Pick ripe fruit and pulp soon after picking.
3. Ferment glucose well to avoid coated beans ; good fermentation is conducive to even drying.
4. Wash well with clean water. Avoid contact with dust.
5. Dry evenly.
6. Do not mix coffees of a different stage of dryness for despatch.
7. Do not split parchment by excessive or too rapid drying.
8. After estate drying keep coffee turned over in heaps and not sacked.

Supplementary remarks.—The buyer requires a coffee which will roast evenly so that some berries may not be turned to charcoal and spoil the roast by taking up aroma. Pea berry roasts evenly and fetches high prices. A uniform coloured coffee generally roasts evenly. A bluish coloured coffee usually liquors better than a grey coloured coffee of equal dryness. Coffee which has lost a little colour during milling would probably roast and liquor as well as a hand-rubbed sample of the same coffee, but if inferior or unevenly dried beans are mixed with either they will show up in the roasting.

The value of coffee depends on form, size, colour, smell, flavour, age and uniformity. Colour appears to depend more on the degree of ripeness when the fruit is picked and care in preparation than on the soil or class of coffee grown.

T. H. HOLLAND.

CERCOSPORA LEAF SPOT OF COFFEE.

COLIN G. WELLES,

Associate Professor of Plant Pathology, College of Agriculture, University of Philippines.

In the PHILIPPINE JOURNAL OF SCIENCE, Vol. 19, No. 6, mention is made of the leaf spot of coffee caused by *Cercospora coffeicola* BERKELY and COOKE as occurring in nursery stock causing rather severe spotting and ultimate defoliation.

The occurrence of the disease at present is negligible.

REVIEW OF LITERATURE.

The leaf spot under discussion is commonly known as "brown eye spot" "brown eyed disease," or "berry spot." These names are derived from the type and appearance of the disease in various localities.

This disease has been reported from Mexico, Cuba, Trinidad, Porto Rico, Java, Uganda, and India. In India the fungus has been found to parasitize the leaves only, but in other places the berry spot is very serious, usually destroying all fruits attacked.

THE DISEASE IN THE PHILIPPINES.

In the Philippine Islands the disease is confined only to leaves, and has been observed only on nursery stock and has not been found on mature trees.

SPECIES ATTACKED.

Five varieties of coffee are grown in the college nursery and out of these only *Coffea bukobensis* has been affected; the unattacked are *Coffea liberica*, *Coffea robusta*, *Coffea congensis*, and *Coffea conophora*. The origin of the disease is not known. *Coffea bukobensis*, the only disease species, has been obtained from the Kaiserliches Biologisch Landwtrschaftliches Institut, Hafen Taya, in 1914, and it is not likely that the disease has been introduced through these seeds as in that case the fungus would have been observed earlier.

SYMPTOMS.

The lesions when young are light brown. Later the centre portion turns grayish, exhibiting concentric striations and encircled by brown rings. The lesions are found mostly on the upper surface of the leaves. At first they do not penetrate through the leaf, but later a distinct spot is produced on the under surface.

In some instances the spots coalesce and form an irregular lesion. In severe attacks the leaves turn brown and fall off, frequently leaving but a tuft of young leaves on a long stem.

CONTROL.

Spraying experiments carried on with Bordeaux mixture prove conclusively that the brown eye spot may be easily controlled.

Spraying every two weeks is recommended. If the attack is limited in extent there is no reason why complete eradication may not be effected.

In Porto Rico shading has reduced the berry loss from 10 to 30 per cent.

COTTON.

COTTON CULTIVATION.

DEPARTMENT OF AGRICULTURE, CEYLON, LEAFLET NO. 19.)

Climate and Rainfall.—Cotton cannot be grown satisfactorily in the wetter parts of the Colony It can be relied upon to give good results in the drier areas, if the following conditions prevail :—

(1) If for the first three months after sowing seed there is a uniform rainfall with falls that are not heavy. It is essential that rain should fall shortly after sowing the seed or otherwise field mice will destroy it. Light showers at frequent intervals are of far greater value than heavier falls with long periods of dry weather between the falls of rain.

(2) If during the fourth month no heavy falls of rains are experienced. Heavy showers during flowering may cause the shedding of flowers and of bolls.

(3) If after the fourth month dry weather can be relied upon. Rain hinders the picking of cotton and spoils much of it.

From the above it is essential that due regard should be given to climatic conditions Otherwise disappointment is certain to result. A district with a total annual rainfall of over 75 inches should be avoided. Satisfactory crops can be grown in localities which receive from 40 to 60 inches of rain annually.

Areas subject to the south-west monsoon should generally be avoided, and areas which receive only the north-east monsoon selected. The best results have so far been obtained in the Hambantota District of the Southern Province, while tracts in the Kolonna korale possess good soil and have the desired rainfall distribution for cotton. In the Northern Province and in the North-Central Province cotton could be grown, although at the end of the year rains are frequently too heavy. Similarly, cotton could be grown in the Eastern Province if sowing was not done until late in the year, and there are some prospects before cotton in parts of Uva and the Matale District of the Central Province.

Land.—The land should have good drainage. Cotton will not tolerate bad drainage. The land should not be too heavy and light, sandy land should be avoided if a satisfactory rainfall cannot be relied upon.

If the land is in jungle or scrub, a good burn off is essential, for thereby bottom weeds are destroyed. The growth of cotton is seriously checked by weeds. It is benefited by the ashes of a good burn. All jungle or scrub should be cut down to ground level.

Tillage in land from jungle is difficult during the first year, and mamotying the rows in which the cotton is to be sown is about the most that can be attempted. In subsequent years tillage must be carefully attended to.

Sowing of Seed.—Only seed of good quality should be used. The germination of seed should be tested before sowing. This can be done by sowing 50 seeds in damp soil in a flower pot. Germination will take place within seven days. When the germination of the seed has been ascertained it will be possible to calculate the number of seed that should be sown per hole. If the seed is good, 4 to 5 seeds per hole should be used. If it is not of high germinative power, a larger number should be sown. To be on the safe side, all growers of cotton should allow for a seed rate of 10 lb. of seed per acre.

Sea Island cotton, American Uplands, or Cambodia should be sown at distances of 2 feet apart in rows 3½ to 4 feet apart. The rows should run from north-east to south-west if possible, so as to minimise the danger of damage by wind. If the soil is good, planting 4 feet by 2 feet is recommended. This was the distance adopted at Ambalantota. For smaller growing varieties 3 feet by 1½ feet may be adopted. On light soils, when growth will not be so luxuriant, closer planting can be adopted than on richer soils.

If 3 or 4 plants are growing in each hole, they should be thinned to 2 when the plants are 9 to 12 inches in height.

Any blanks should be immediately re-supplied with seed. Do *not* attempt to transplant. The transplanting of cotton seedlings does not pay.

Cultivation.—On jungle land much inter-cultivation will not be necessary unless the land is heavy. It must, however, be kept quite clean from weeds. Weeds soon stop the healthy growth of cotton in its early stages, and may eventually smother out the young cotton seedlings if weeding is neglected. *It pays to weed cotton.* Unless this is done poor crops can only be expected.

When the plants are 2 feet high, soil should be drawn towards the young plants. This can be done with a mamoty when weeding operations are being carried out. The soil hilled up round the young plants should be 2 to 3 inches high. It assists plants and helps to prevent their being blown over by wind.

If the land is not new land from jungle more cultivation is necessary. This can be done with mamoties at the time of weeding. A good tilth should be aimed at. Early cultivation in cotton pays and the land should be kept in good tilth up to the time of general flowering.

Manuring.—This will not be necessary for the first crop, but subsequent crops, particularly if grown on the same land, should receive up to 100 lb. of nitrate of soda per acre. This should be applied before the seed is sown. Some growers, however, may advocate application when the plants are 6 inches high. Basic slag is also a good manure for cotton.

Pests and Diseases.—Cotton should be examined every day during the growing period for pests and diseases. This work is most essential, for pests often cause very serious damage, and it is only by detecting them in the early stages that this damage can be prevented.

All Imbul, Katu-imbul, or Suriya trees should be cut down from areas where cotton is being grown. Also all malvaceous shrubs and weeds should be destroyed. Pests of cotton often breed upon these plants, and if these wild plants (alternative hosts of cotton pests) are controlled, damage by pests is minimised.

The following pests may be anticipated :—

(1) Aphids. These are not usually serious, and are controlled by their natural enemies. If they become serious, spray affected plants with kerosene emulsion or tobacco solution.

(2) Leaf Roller (*Sylepta derogata.*) This is occasionally serious. All caterpillars should be collected from the folded leaves or crushed in the folds.

(3) Boll Worms (*Earias* spp.) The caterpillars bore into young shoots, buds and flowers, and later into the bolls. The affected parts must be collected and destroyed and attacked bolls similarly dealt with.

(4) Pink Boll Worm (*Platyedra gossypiella*). May become a serious pest. It bores into bolls and destroys seeds and cotton. All attacked bolls should be collected throughout the whole season and burnt. At the end of the season all old unpicked bolls should be burned and all stems uprooted and thoroughly burned. It is only by clean cultivation that this pest can be kept in check.

(5) Red Bug or Stainer (*Dysdercus cingulatus*). This punctures the bolls and assists in staining cotton. It should be collected and destroyed.

6) Dusky Cotton Bug (*Oxycarenus laetus*). This is found on old bolls. It should be collected and destroyed.

Egg masses of insects noticed in the fields on the leaves should always be collected and destroyed. At the end of the season it is essential that all old plants should be rooted up and burnt. Similarly, all plants detected with disease should be removed as soon as possible.

Harvesting.—At an early stage plants burst a few bolls. They should be left alone. It does not pay to gather the crop in small quantities. The greatest care should be exercised in plucking the cotton clean. Never permit a cooly to offer dirty cotton, with little broken pieces of leaf in it ; have it all carefully picked over. This is most important. The whole financial success of cotton depends upon its cleanliness. It must be absolutely clean, and to secure this the greatest care and vigilance is necessary. A conductor who is slack in this respect is useless. One dirty bale will condemn the rest of the shipment and make a difference between a very substantial profit and a serious loss. Once a reputation for clean cotton is gained, your cotton will always command a ready sale. Never pick when the cotton is damp with dew or after rain, or before the bolls are properly open and the cotton quite ripe.

When it is received at the store have it spread out on a platform, exposed to the sun, so as to dry. The first, second, and third pickings should always be kept quite separate and the sacks marked. Check all weights carefully. Weigh each picking, weigh the bulk to make certain of being correct, and also to avoid being cheated by the pickers. Get the cotton ginned as soon as possible in order to avoid loss from squirrels and rats and stow away in a dry place.

Crop Periods.—If cotton is sown with the first rains of October, some picking will begin at the end of January. The first picking should be completed by the end of March. Flowering will commence again in early April, and the result of the second picking will depend upon the showers of that month. The second crop should be ready for picking during May and June. All cotton should be removed before July 15 and all stems burnt, particularly if a second crop of cotton is to be grown. The removal and burning of the stems of one crop two months before the time of planting the next is most essential. It is the only satisfactory means of keeping in check such pests as pink boll worm and cotton stainers. Many cotton-growing countries have adopted legislative measures to make such precautions compulsory. If cotton-growing extends in Ceylon, similar measures will be necessary in the interests of the industry.

F. BURNETT,
Divisional Agricultural Officer.

May 4, 1922.

COTTON EXPERIMENTS IN CEYLON, 1921-22.

MEMORANDUM READ AT A MEETING OF THE BOARD OF AGRICULTURE.

The success that had been obtained in recent years from small areas of Cambodia cotton warranted further experiments being carried on by the Department of Agriculture. Previous experiments had been carried out in the North-Central Province with Indian, Egyptian, Upland, and Sea Island varieties, and yields of 400 to 550 lb. of seed cotton per acre were obtained. Experiments were also made in the Kurunegala District by private enterprise, and some fairly satisfactory results secured. Seed of Cambodia cotton had been introduced by the Agricultural Society, and good results had been obtained in the Hambantota District, especially by the Mudaliyar of Magam pattu.

It was therefore decided to make further tests in the Hambantota District, and to endeavour to encourage villagers to take up the cultivation, by distribution of seed and by a guarantee to purchase the crops raised at a fixed rate. A total of 1,951 lb. of Cambodia seed was distributed for the season 1921-22, and a guarantee to purchase all crops grown by small cultivators in the Hambantota District was given.

The results of the experiments, which were begun in July, 1921, are given in detail up to the end of the first picking. Felling was commenced in July, and the "burn off" was completed before the end of September. Sowing began on October 10, with the first rains. The earliest sown cotton has been uniformly the best throughout, and areas which were covered with a fair amount of scrub jungle and which burned off well have given the least trouble with weeding. In areas which had previously been cleared, weeding was excessively heavy, and some check to the growth of the cotton plants occurred. The effect of weeds on the growth of cotton was most marked, and it was only by strenuous efforts that weeding was completed at the critical time in the growth of the cotton.

The actual yields of the first picking have been as follows :—

Variety.	Total Yield. lb.	No. of Acres.	Yield of Seed Cotton per Acre. lb.
Cambodia ...	18,411	... $29\frac{3}{5}$	... 622
Durango (American Upland	12,782	... $18\frac{1}{2}$	... 690
Karanganny ...	2,938	... $6\frac{1}{2}$	... 452
Sea Island ...	1,088	... $1\frac{5}{6}$	... 593
Sakellaridis } Egyptian	770	... $2\frac{2}{5}$	... 312
Assili } Egyptian	148	... $\frac{1}{3}$	... 444
Aschmouni } Egyptian	96	... $\frac{1}{3}$	... 288
Cauto (American) ...	108	... $1\frac{1}{30}$	... 294

The actual expenditure incurred to date upon 60 acres of cotton at Ambalantota and Kiula has been as follows :—

Capital Expenditure.	RS.	C.	*Recurring Expenditure.*	RS.	C.
Clearing and burning 60 acres	1,887	50	Hoeing lines for planting and sowing	1,457	18
Building sheds for coolies	178	35	Cost of seed ...	60	00
Fencing ..	335	84	Weeding ...	1,278	14
Bags ...	71	05	Harvesting ...	911	28
Implements ...	590	15	Sundries ..	75	95
	3,062	89		3,782	55

Total ... Rs. 6,845·44.

It has to be considered how the capital expenditure should be distributed. It is probably reasonable to distribute this expenditure over five years. In any case the total expenditure to date has been Rs. 114 per acre.

The crop has not yet been sold, but 5 tons have been supplied to the Spinning and Weaving Mills, Colombo. The Cambodia has been valued at Rs. 20 per cwt. of seed cotton, the Karanganny at Rs. 16 per cwt., and the American Upland at Rs. 35 per cwt. of seed cotton. Arrangements are also being made for the return of seed for supplies for planting purposes.

The American Upland is of a very good quality, and would command a ready sale in any cotton market. The Cambodia is of average quality, being slightly irregular in length of staple. Attempts will be made to secure a fresh strain of Cambodia and to carry on with the present seed of American Upland. If the quality of this cotton can be maintained, then there are considerable possibilities before cotton growing in Ceylon.

It remains, therefore, to consider what steps shall be taken to popularize cotton growing, and what further experiments shall be made. The Spinning and Weaving Mills, Colombo, encouraged by our results, are going to take up nearly 400 acres adjoining the Ambalantota area, and the fullest possible assistance will be given to them by the Department. This firm is prepared also to specify for some years at the beginning of each cotton season the price that they will guarantee to a Ceylon-grown crop. In May of each year they are prepared to guarantee a price for the following year, at least until the cotton crop becomes an important one. This should prove of value in the establishment of an industry. There remains to be considered the following :—

(1) Free distribution of seed.

(2) Guarantee of price by Government, in co-operation with the Spinning and Weaving Mills, to all small growers.

(3) The establishment of purchasing centres to which cotton may be brought, and the provision of arrangements for transport of same.

It has also to be considered whether one area at a time should be concentrated upon, and whether further experiments by the Department of Agriculture in other districts are desirable. The advice of the members of the Board of Agriculture on the various points raised by this short memorandum are sought, in order that a definite policy may be decided upon.

F. A. STOCKDALE,

Director of Agriculture.

May 4, 1922.

FOODSTUFFS.

MILK AND ITS USES IN THE HOME.*

The following extracts are taken from FARMERS' BULLETIN 1207 of the United States Department of Agriculture :—

COMPOSITION OF MILK.

Milk as it is drawn from the cow is an opaque, whitish liquid, which varies considerably in appearance and in flavour. It is commonly described as consisting of a thin, bluish-white, somewhat transparent liquid, called the plasma, in which are floating numerous minute yellowish globules of fat. Many analyses show the average composition of milk to be : Water, 87 per cent ; protein, 3·3 per cent ; fat, 4 per cent ; milk sugar, 5 per cent ; and mineral matter, 0·7 per cent.

Milk is slightly heavier than water, its specific gravity ranging from 1·029 to 1·304 at 60°F. This means that while a quart of water weighs 2 pounds $1\frac{1}{3}$ ounces, a quart of milk weighs 1·029 to 1·034 times 2 pounds $1\frac{1}{3}$ ounces, or not far from 2 pounds $2\frac{1}{2}$ ounces. The specific gravity depends upon the proportion of water and other substances. Since the fat is lighter than water, the richer the milk is in butter fat the lower its specific gravity, provided, of course, the other solids are not increased proportionally. It follows also that the removal of the fat increases the specific gravity, so that skim milk has a specific gravity of from 1·033 to 1·037.

The freezing point of milk also varies with the composition, falling as the proportion of solids increases and rising as water is added. In average milk it is about 31°F.

PROTEIN COMPOUNDS.

Protein compounds are important nitrogenous ingredients of food indispensable in the formation of body tissues and fluids. They may also be burned in the body to furnish energy. Protein in food takes different forms, for example, egg albumin in the white of egg, myosin in lean meat, and legumin in peas and beans. These forms of protein, both in food materials and in the human body, are made up of various combinations of amino-acids ; and the proteins in foods are spoken of as more or less adequate according as they yield a large or small proportion of the amino-acids needed by the body.

The total amount of protein varies somewhat in milk from different cows, but averages about 3·3 per cent. by weight of the whole milk. The principal protein compound in milk is casein, which because of its phosphorus content is classified as a phospho-protein. Albumin, in the special form of lact-albumin, is present in much smaller amounts, being on the average about one-seventh of the total protein. The proportion of albumin to casein varies in the milk of different kinds of animals, of different cows, and also in the milk of the same cow. Both of these compounds are

* Prepared in the office of Home Economics with the co operation of the Dairy Division Bureau of Animal Industry.

adequate proteins, as are also the proteins found in eggs and meat. There are other nitrogenous substances occurring in milk, but in such small quantities that they need not be considered here.

When sufficient acid is added to milk, or develops in it from the action of the lactic-acid-forming bacteria, the casein is precipitated in light, white flakes. Another kind of precipitation occurs when rennin is added, as in making cheese or junket. This ferment is present in human gastric juice, also in the lining of calves' stomachs, from which it is extracted for commercial purposes. Junket tablets and liquid rennet are preparations containing this ferment.

FAT.

The fat of milk is the most important of its constituents commercially, since it is the source of butter and enters largely into the composition of cheese. This fat, known as butter fat, is made up of different fats, severa of which (sterrin, palmitin, and olein) are also present in large proportions in the fat from meat, tallow, and lard for example, as well as in many vegetable oils. However, butter fat differs from the fats of most other foods in containing also certain volatile acids.

The amount and character of fat in milk varies widely. The amount should not fall below 3 per cent. by weight, and except in unusually rich milk does not exceed 5 per cent. It averages about 4 per cent. of the milk, or about 31 per cent. of the total solids. It is found throughout the milk in emulsified form, that is, in small globules, which vary in size in the different kinds of milk. Since these globules are lighter than water, they tend to rise to the top of the milk as it stands, thus forming cream. Cream is not pure butter fat but contains much fat mixed with smaller amounts of the other ingredients of milk. The cream should measure about one-fifth of the total volume.

MILK SUGAR.

The carbohydrate of milk is lactose, or milk sugar. It is similar in chemical composition to cane sugar, but does not dissolve so readily and is far less sweet. The amount of milk sugar in cow's milk varies from 4 to 6 per cent. the average being about 5 per cent. of the total milk, or 38 per cent. ot the total solids.

Most of the milk sugar remains in the whey when casein or curd is removed in cheese making, and may be easily separated from it. Milk sugar may be obtained in crystals, but is usually marketed as a fine white powder much like confectioners' sugar in appearance. It is used in modifying milk for babies, as a vehicle for drugs, and in many other ways. Its manufacture is an important industry.

MINERAL MATTER.

The ash constituents in milk consist mainly of the phosphates and chlorids of soda, potash, and lime, and make about 0·7 of 1 per cent. of the whole milk, or 5 per cent. of the solid matter. The ash as a whole is neutral or slightly alkaline, differing in that respect from the ash in the other animal foods.

The three mineral substances in which American dietaries are often deficient, even when otherwise adequate, are phosphorus, iron, and lime, or calcium. Phosphorus in both organic and inorganic forms is relatively abundant in milk. Milk does not contain much iron, but what little is present is in an unusually available form. Milk is, however, much richer in lime than other common foods. This is one of the reasons why it is such an excellent food for children; it furnishes lime for the building of bones and teeth.

VITAMINES.

Vitamines are recently discovered constituents of certain foods. Relatively little is known about the nature of these vitamines save that they are indispensable for normal health and growth and that if they are left out of the diet for a long period, so-called "deficiency diseases" develop. At least three kinds are now recognized which, until more satisfactory names are agreed upon, may be designated as vitamine. A (soluble in fat and sometimes called antirachitic, because the absence of it is believed to induce rachitis, or rickets, in children), vitamine B (soluble in water and sometimes called antineuritic or preventive of polyneuritis and beriberi), and vitamine C (soluble in water and sometimes called antiscorbutic, or preventive of scurvy). All three are present in milk.

Vitamine A is of especial importance for two reasons. One is that without it children can not grow and develop normally, even though their food is otherwise sufficient for their needs. The second reason is that vitamine A is found in such foods as milk, egg, yolk, green-leaf vegetables, fats surrounding the vital organs of animals, to a less extent in meat, and perhaps in certain fruits, and in few so abundant as in milk. It appears to go with the milk, fat and so is found in whole milk, cream, and butter.

Vitamine B is found in most foods except those which have been artificially purified, such as white flour, cornstarch, polished rice, refined sugar, and most table oils.

Vitamine C is known to be supplied by certain fruits and vegetables and milk. Its efficacy in milk seems to be easily destroyed, and absolutely fresh, uncooked milk is the only milk that should be relied on to supply it.

FOOD VALUE OF MILK COMPARED WITH SOME OTHER FOODS.

It is a commonplace saying that milk is a perfect food. This may be taken to mean that it contains, first, materials that children need for growth; second, materials that young and old alike need for the repair of their body machinery; and third, materials that all need for fuel, to provide them with heat and with the energy necessary for work Such a statement should not be understood to mean that milk has these ingredients in such proportions that it can serve satisfactorily as an exclusive food for a grown person or even for a child. To the growing child, however, no other food can satisfactorily replace milk as a part of the diet. Each child should take a full quart of milk each day, but at least a pint without fail.

Iron is a food ingredient that the body needs in greater amounts than are found in milk. This lack is not dangerous for infants because there is a supply of iron in their bodies at birth on which they can draw to supplement the small amount in milk, but older children and adults need more generous supplies, such as can be obtained from egg yolk, meat, whole cereals, and fruits and vegetables, such as prunes and raisins, spinach, and beet tops.

That milk is much more than a beverage is not recognized by everybody. The following table shows that, as a source both of energy and of protein, milk ranks with other foods rich in these respects

MILK AS A SOURCE OF PROTEIN AND ENERGY.

Protein Value	Energy Value
1 quart of milk contains as much protein as :—	1 quart of milk yields as much energy as :—
7 ounces of sirloin steak	11·3 ounces of sirloin steak
6 ounces of round steak	14·9 ounces of round steak
8·6 ounces of fowl	14·5 ounces of fowl
4·3 eggs	9 eggs

Milk and milk products can be used interchangeably with meats and eggs as a source of protein. A quart of milk contains as much protein as 5 ounces of dried beans or a 12-ounce loaf of bread, and while the legumes and cereals are considered a cheap source of protein it should be remembered that their proteins are not so completely utilized for tissue building as those in milk, meat, and eggs.

Though milk is an extremely valuable food, differing from all others, except possibly eggs, in that it contains fairly good proportions of almost all the ingredients necessary for the building and repair of the body and for supplying the energy for its activities, the ingredients are so diluted with water that a large quantity (5 or 6 quarts each day) would be required to meet the needs of an adult. Also in order to get the required amount of energy from milk, unnecessary quantities of protein would have to be consumed. Furthermore, healthy digestive organs can do their work better when at least part of the food is in solid form, though even for adults, milk alone can support life for a considerable time, if not indefinitely. The chief value of milk is in combination with other foods.

DIGESTIBILITY.

The amount of nourishment that any kind of food furnishes to the body depends not only upon the food materials that it contains, but also upon how much of those materials the body can actually utilize. Whether milk is to be classed as a digestible or indigestible food will therefore depend upon the proportions of protein, fats, carbohydrates, and mineral matter that the digestive organs of the average normal person are found to transform into material available for the use of the body.

No one element of the various digestive juices; which act upon the food as it passes through the alimentary canal, acts upon all classes of nutrients. All are digested separately, though in some cases at the same time. Since milk contains considerable quantities of each class of nutrients, the way in which it is digested can be better understood by following the changes in each nutrient separately.

The protein compounds are usually considered as giving the most trouble in the digestion of milk, mainly because of the casein. Milk is commonly classed as a liquid food, and so it is until it reaches the stomach. There the rennin of the gastric juice precipitates the casein into a curd from which the other ingredients are separated, much as the whey separates from the curd in cheese making. The acid and the pepsin of the gastric juice together work upon the curd and render a small part of it more soluble, but the bulk of the casein is digested in the small intestine by the trypsin of the pancreatic juice. Experiments* have shown that casein which has not been curdled by rennin is more completely digested by trypsin than the curdled casein. Apparently, then, the formation of the curd, especially when tough and leathery, means extra work for the digestive organs. Limewater is sometimes added to milk to prevent such a curd, which is especially likely to form when considerable calcium phosphate is present.

The albumin of milk is for the most part easily digested by either the pepsin or the trypsin.

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* Archiv. Physiol., Nov., 1902. p. 605.

The digestion of fats depends mainly upon getting the globules into such fine size that they may be easily passed through the walls of the intestines. Separating the fat into such tiny globules is called emulsification. Another change, saponification, also helps in the absorption of fat. The alkaline pancreatic juice unites with the acids of the fat to form a soap, while the glycerin is set free, much as in ordinary soap making. Both the soap and the glycerin are more easily absorbed than the original fat.

The digestibility of any fat depends on the temperature at which it melts, and milk fat, which, as every one knows, grows soft in a warm room and liquefies at about the temperature of the body, is more digestible than those which require more heat to soften them.

The character of the globules may also have some effect on digestibility, and since those in milk are smaller and more easily emulsified than those in other foods, milk fat is considered especially good for invalids and children. The size of the globules varies in milk from different breeds of dairy cattle. There is a theory that the fat of milk containing the larger globules—that is, milk on which cream rises freely, such as the milk from Jersey or Guernsey cows—is less easily digested than that in which smaller globules remain longer in suspension. A mechanical process has recently been introduced by which the globules in milk can be made very small and so mixed through the milk that they will not rise to the surface in the usual way. This is known as homogenization. It does not appear to destroy any of the nutritive qualities of the milk, and seems likely to prove useful in modifying milk for infants and invalids as well as in other ways.

The bulk of the milk sugar is believed to be digested by one of the ferments of the pancreatic juice after it passes from the stomach into the intestines.

It is commonly supposed that the lactic acid of sour milk is changed to simpler bodies in the digestive tract and assimilated, and its presence may be beneficial in checking the growth of putrefactive bacteria that cause intestinal disorders.

Experiments show that the major portion of milk and milk products leave the stomach within an hour and a half.

PROPORTION OF NUTRIENTS DIGESTED.

In connection with the nutrition investigations of the Department of Agriculture, many experiments have been made to determine how thoroughly the protein, fats, and carbohydrates of milk are digested and assimilated, and much similar work has been reported by other investigators. The results obtained vary within rather wide limits, owing either to indivdiual peculiarities of the subject or to conditions under which the milk was taken.

For persons who digest milk well the average coefficients of digestibility may run as high as 98 per cent. for protein, 99 per cent. for fat, and 99 per cent. for carbohydrates. The average values for animal food are 97 per cent. protein, 95 per cent. fat, and 98 per cent. carbohydrates. In general it seems fair to say that milk is on the average as well or even more thoroughly digested than other animal foods.

When milk is the only food eaten by healthy adults, considerably less of the nutrients supplied are assimilated than is the case when it forms a part

of a mixed diet. Taking other food with the milk hinders the formation of the lumps of casein in the stomach and so makes the milk easier to digest. Of course, very young children digest mothers' milk alone better than any other food, but this is because of the peculiarities of their digestive organs, to which such milk is thoroughly adapted by nature, both in composition and in physical properties. If other milk is substituted for mothers' milk it must usually be modified for best results. For adults in poor health, milk is commonly an important food, and many individuals whose digestive organs are not in good condition can derive more benefit from it than from any other single food.

MILK FOR INFANTS.

That the best food for infants is milk from strong, healthy women is universally admitted. When this is not obtainable the more nearly the substitute resembles it the better. The milk of the ass and the mare is in many important respects more like human milk than is that of the cow, and their milk used frequently to be given to babies. Goat's milk, too, is highly thought of. At present cow's milk is the most common substitute, and when necessary is artificially modified to make it resemble human milk more closely.

Cow's milk contains more protein, less sugar, and slightly less fat than woman's milk, as shown in the following table :—

AVERAGE COMPOSITION OF MILK OF VARIOUS KINDS.

Kind of Milk	Water	Total Solids	Protein			Fat	Carbohydrates (milk sugar)	Mineral matters	Fuel Value per pound
			Casein	Albumin	Total				
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
Woman -	88·3	11·7	—	—	1·2	3·3	7·0	0·3	285
Cow -	87·0	12·8	2·8	0·5	3·3	4·0	5·0	·7	315
Goat -	85·7	14·3	3·5	1·0	4·5	4·7	4·4	·8	355
Sheep -	81·9	18·1	—	—	5·3	7·3	4·7	·9	480
Buffalo (Indian)	82·2	—	4·3	·5	4·8	7·5	4·8	·8	480
Camel -	87·1	—	3·5	·4	3·9	2·9	5·4	·7	285
Llama -	86·6	—	3·0	·9	3·9	3·2	5·6	·8	305
Reindeer -	67·2	—	8·4	1·5	9·9	17·1	2·8	1·5	930
Mare -	90·6	9·9	1·3	·8	2·1	1·1	5·9	·4	190
Ass -	90·1	10·4	·8	1·1	1·9	1·4	6·2	·5	205

Cow's milk also has larger fat globules ; there is more casein in proportion to the albumin ; and the casein is said to form a tougher curd than that of human milk. The deficiency in milk sugar in the cow's milk can easily be made good by adding either milk sugar itself or some other digestible carbohydrates, such as rice flour or arrowroot. The fat globules can be broken down by the homogenization and rendered more like human milk. The casein also may be made more easy of digestion by the addition of limewater, or may be artificially predigested by peptonizing or by boiling, but nothing can exactly reproduce the protein of human milk. For this reason perhaps more than for any other, cow's milk, no matter how skillfully modified, is never quite so satisfactory as human milk for infants.

Fortunately, most healthy babies thrive on good cow's milk or cow's milk simply modified. It is the sickly who require special preparations, and their needs vary so greatly that only the physician acquainted with the case, and not always he, can say what change is necessary. There are laboratories in many large cities and towns where modified milk of all sorts can be procured on prescription.

All babies fed on raw cow's milk are in more or less danger from the undesirable bacteria which it may contain and which cause diarrhœa and other serious infant disorders. The methods of pasteurizing and sterilizing milk to avoid this danger are discussed later in the article. When raw-milk is used great pains should be taken not only to obtain fresh, clean milk from tuberculin-tested cows, but, also to care for it scrupulously after it is purchased. It is usually more important that the milk should be pure than that it should be rich in cream. Especially as the fat in very creamy milk may be less digestible on account of the size of the fat globules. Specially "certified" raw milk produced and bottled under strictly sanitary conditions is for sale in most large cities, necessarily at a high price to cover the expenses of rigid inspection.

BACTERIA IN MILK.

Besides the chemical compounds, milk also contains large numbers of minute organisms called bacteria. Few, if any, are normally present in the milk within the udders of clean, healthy cows, but they are so abundant everywhere in the air, especially about the stable and barnyard, and cling in such numbers to the bodies of the cows, that they are almost always found in milk as soon as it leaves the udders or even just inside the teats. Utensils that have not been sterilized are another very common source of bacteria in milk. Bacteria reproduce very rapidly in a favourable medium, such as warm milk, and the number present becomes very large unless measures are taken to hinder their increase. The amount in milk of a given age varies of course with the conditions.

A great many kinds of bacteria have been found in milk, each of which occasions a special set of changes as it develops. Perhaps the most prevalent kinds are those that cause the ordinary souring of milk and are the first to produce any noticeable change in the taste and odour. In their growth they feed upon the milk sugar and convert it into lactic and volatile acids, which give slightly soured milk its peculiar taste and odour. When enough of this lactic acid has formed it acts upon the casein, causing it to separate into loose, light flakes and to form, upon standing, the ordinary "clabberyd" milk. Other bacteria developing in sour milk may give it a strong, unpleasant odour or flavour, and still others, which occur occasionally, colour it very brightly or give it a slimy or ropy consistency. Some of the products of bacterial action on milk are desirable, however, for instance those that give to butter and cheese the characteristic flavours and odours.

HOW TO PASTEURIZE MILK AT HOME.

Milk and cream for ordinary use or milk for feeding infants may be successfully pasteurized at home. The process is not difficult and requires only simple equipment. A pail somewhat deeper than the bottles containing the milk and with a perforated false bottom is perhaps the most convenient utensil in which to heat the milk. An inverted pie tin with a few holes

punched in it serves very well as the false bottom, its purpose being to raise the bottles from the bottom of the pail, allowing free circulation of water and preventing the bottles from bumping. A good thermometer with the scale etched on the glass is needed. The ordinary floating dairy thermometer is likely to be inaccurate.

For general use, milk is most conveniently pasteurized in the bottles in which it has been delivered. Pour out a little of the milk, replace the covers, punch a hole through the cap of one of the bottles, and insert the thermometer. Set the bottles of milk in a pail, fill with cold water nearly to the level of the milk, and heat the contents until the thermometer in the milk registers 145°F. Remove the pail from the flame and allow the bottles to remain in the water for 30 minutes, reheating if necessary to maintain the temperature of 145°. After the 30-minute period, replace the hot water gradually with cold until the temperature of the milk is reduced to 50°F. If necessary use ice in the water to bring the milk to this temperature. After cooling, put the bottles in the refrigerator and keep them at 50°F, or less.

Milk for infants is best pasteurized in the nursing bottles in the quantity needed for each feeding. It is then in the most convenient form to use, and there is no possibility of contamination by pouring in into other bottles. It is customary to pasteurize enough at a time to last for 24 hours. Milk in these smaller bottles is pasteurized by a slightly different method than it is in ordinary bottles. A wire or tin basket that holds the bottles upright in the hotwater bath and makes it posssible to handle them all at one time and without scalding the fingers is a great convenience.

Pour into each bottle the exact quantity of milk required for a feeding, after modifying it, if necessary according to directions. It is wise to prepare an extra bottle, for there is always the possibility that one may be broken during pasteurizing. Adjust the seals, or plug the tops of the bottles with clean ordinary (not absorbent) cotton, and insert the thermometer in one of them. Place the bottles in wire basket, set it in the pail, fill the pail with water nearly to the level of the milk, and heat until the thermometer in the milk registers 145°F. Remove the bottles, change the thermometer from the milk to the water, and add cold water until the temperature of the water is also 145°F. Put the bottles back into the water, cover them with an old bath towel or other heavy suitable cloth, and let them stand for at least 30 minutes. Then cool them as much as possible by running cold water into the pail, and store them in the refrigerator, or still better pack broken ice about them before putting them in the refrigerator. Remove the milk, bottle by bottle, from the refrigerator as needed. If a bottle is warmed and not used, discard it : do not return it to the refrigerator to be used later.

CARE OF MILK IN THE HOME.

No matter how well milk has been handled up to the time it is delivered to the consumer, it can not be expected to keep well if it is then carelessly treated. Milk should be kept clean, covered, and cool ; these three points, consumer as well as producer should never disregard.

SUMMARY.

Milk is one of the most important foods, in spite of the fact that it is about seven-eighths water. With a few exceptions, it excels all other foods in the variety and quality of materials that it furnishes the body, and is suitable for persons of all ages.

The solids of milk comprise protein, fat, sugar, and mineral matter, all in such form that they can be easily utilized in building and repairing the tissues and bones of the body. Milk is far richer in lime, for example, than other common foods, which makes it especially valuable for young children who need lime to build bones and teeth.

Fresh whole milk also contains all three of the vitamines, constituents of certain foods found by scientists to be necessary for the maintenance of health and normal growth. Milk fat is frequently the most readily available source of vitamine A, which children must have in order to grow and develop normally.

The commission on milk standards of the New York milk committee is recommending the general adoption of a standard for milk calling for at least $3\frac{1}{4}$ per cent. fat and $8\frac{1}{2}$ per cent. solids. Such a standard is a fair basis from which to judge the quality of market milk and also to regulate the price.

Certified milk is a special grade produced in establishments rigidly inspected and vouched for by a medical milk commission and must therefore conform to a high standard of purity.

Milk is one of the easiest of all foods to digest, for the normal healthy person and for many invalids as well.

For infants cow's milk often needs to be artificially modified so that it more nearly resembles woman's milk, in which the fat globules are much smaller and there is more sugar.

Milk should be kept clean, covered, and cool from the time it is drawn from the cow until it is used, in order to prevent the bacteria in it from developing and causing it to spoil.

Even milk that looks clean may contain germs of such diseases as typhoid fever, tuberculosis, scarlet fever, septic sore throat, and diphtheria, if drawn from diseased cows, if handled by persons carrying the germs of these diseases, or if the utensils and containers are washed in polluted water, or if the milk is contaminated by flies.

Pasteurizing milk, or holding it at a temperature of 145°F. for 30 minutes, is the best practicable method of destroying disease producing bacteria without producing undesirable chemical changes in the milk itself. Milk for general use or for infant feeding can be successfully pasteurized at home, and this should be done if there is any question about its purity.

The consumer must share with those who produce and handle milk the responsibility of keeping it sweet and pure until used. It must be kept in a clean, cool place free from undesirable odours and put only in scrupulously clean vessels.

The care of the refrigerator plays an important part in the keeping quality of milk stored in it. It should be inspected at least each week and thoroughly cleaned at regular intervals.

Skim milk, although lacking in fat, is a highly nutritious food especially useful in cooking or combining with other foods. It contains practically all the protein, sugar, and mineral matter of the whole milk.

Condensed, evaporated, and dried milk may be used for many purposes in place of fresh milk when the latter is not available. For feeding children they do not, however, entirely take the place of fresh milk and need to be supplemented by fresh green vegetables and fruit juices.

The fat in cream and butter is very thoroughly and easily digested and carries with it relatively large amounts of the necessary growth-promoting vitamine A.

Cheese contains almost all the protein and fat and much of the sugar and mineral matters of the milk from which it is made. Ordinary American, or Cheddar cheese, for example, contains a far higher proportion of calcium than does any other common food.

TRANSPLANTING OF PADDY IN KANDY.

W. MOLEGODE,

Agricultural Instructor.

Results of several further trials made during the last *Maha* cultivation to ascertain the least number of seedlings it is necessary to transplant and yields obtained from a number of fields transplanted either with too many or two few seedlings go to show that a definite rule for general adoption in Kandy district cannot be made. It will be observed from results given below that planting of single seedlings or two seedlings cannot at present be recommended. Curiously, when some years back a test similar to one marked A. below was tried the best results were obtained from single seedlings. When attached to the Ceylon Agricultural Society I remember dealing with some carefully prepared reports on the results of transplanting experiments which showed that striking results were obtained with single seedlings, for instance at Ambalangoda, Horana, Matara, Rayigama, etc. Whether like in India, where in the Madras Presidency excellent results have always been obtained with single seedlings while the same method of transplanting has failed to give the desired results in, for instance, Bihar and Orissa, that there are areas in Ceylon well adapted to single seedlings can be ascertained only by further carefully conducted trials. In the Kandy district trials have been made during the last 12 years and the results have shown that with the prevailing conditions 3 or 4 plants, not too far apart on ordinary fertile soil and not too close on recognised fertile fields, is a good system to adopt.

Trial A. 1921-1922. *Centre.*—Kondedeniya (Harispattu)

Single seedlings 6 inches apart	34	bushels per acre
Two seedlings do	40	,, ,,
Three seedlings do	48	,, ,,

Trial B. 1921-1922 *Centre.*—Katugastota (Yatinuwara)

Two seedlings 6 inches apart	36	bushels per acre
Three seedlings do	47	,, ,,

Trial C. 1921-1922 *Centre*—Watuwela (Harispattu)

Two seedlings 5 inches apart	26	bushels per acre
Three seedlings do	29½	,, ,,
Four seedlings do	30	,, ,,

N. B. Poor crop for this field. It is a high yielding one. The whole of this range of fields gave poorer crops than previous years.

Trial D. 1921-1922 *Centre.*—Siyabalagastenne (Yatinuwara)

Two and three seedlings 6 inches apart	38	bushels per acre
Three and four seedlings do	46	,, ,,
Four and five seedlings do	42	,, ,,

Trial E. 1921-22 *Centre.*—Mavilmade (Yatinuwara)

Three seedlings 5 inches apart	49	bushels per acre
Four seedlings do	54	,, ,,

N. B. Crop below the average. Suffered owing to lack of water.

Example A. Werellagama (Harispattu)

Two seedlings 5 inches apart	42	bushels per acre
Adjoining fields transplanted unsystematically, but larger number of seedlings per hole	54	,, ,,

Example B. Mavilimade (Yatinuwara)

Three seedlings 5 inches apart	46	bushels per acre
Adjoining fields 3, 4, 5 seedlings at 4, 5 and 6 inches	39	,, ,,

CEYLON AGRICULTURE.

BOARD OF AGRICULTURE.

Minutes of a meeting of the Board of Agriculture held at the Victoria Commemoration Buildings, Kandy, at 2-30 p.m. on Thursday, May 11, 1922.

HIS EXCELLENCY THE GOVERNOR presided.

Present :—The Hon. the Colonial Secretary, the Government Agent, C. P., Kandy ; the Director of Agriculture, the Hon. Mr. J. H. Meedeniya, Adigar, the Hon. Mr. H. L. De Mel, C.B.E., the Hon. Mr. T. B. L. Moonemalle, the Hon. Mr. James Peiries, the Hon. Mr. O. C. Tillekeratne, Lieut.-Col. T. G. Jayawardene, Lieut.-Col T.Y. Wright, Lieut.-Col. L. Bayley, Messrs. A. W. Beven, C. W. Bibile, Ratemahatmaya ; N. G. Campbell, W. Coombe, L. A. Dassanayake, Gate Mudaliyar ; C. Drieberg, E. F. Edirisinghe, Mudaliyar ; H. D. Garrick, E. W. Keith, A. S. Long-Price, W. R. Matthew, S. Muttutamby, P. B. Nugawela, Ratemahatmaya ; Graham Pandittasekera, A. E. Rajapakse, Gate Mudaliyar; R. A. Senior White, W. A. de Silva, E. C. Villiers, A. A. Wickremasinghe, M. L. Wilkins, the Government Veterinary Surgeon, the Government Agricultural Chemist; the Entomologist, the Economic Botanist, the Botanist and Mycologist, the Divisional Agricultural Officer, Central and Mr. R. Aluwihare (Secretary).

Visitors :—The Hon. Robert Trefusis, the Hon. Mr. E. R. Tambimuttu, Messrs. C. C. Ryan, A. M. Cooper, J. E. P. Rajapakse and K. Bandara Beddewela.

The minutes of the previous meeting held on August 24, 1921, were taken as read and confirmed.

Agenda Item 1.—Election of Committees.

The DIRECTOR OF AGRICULTURE proposed that the names on the printed list which had been circulated to the members be approved as members of the various Committees of the Board of Agriculture for the forthcoming year with the addition of the name of MR. K. BANDARA BEDDEWELA, who was appointed to serve on the Food Products Committee of the Board of Agriculture.

Agenda Item 2.—Report on Work of Board.

The DIRECTOR OF AGRICULTURE read his report on the work of the Board of Agriculture during the year 1921.

Agenda Item 3.—Resolution re Food Production.

The following resolution, standing in the name of the HON. DR. H. M. FERNANDO, was formally moved by MR. W. A. DE SILVA in the former's absence:—

"In view of the fact that Government has abandoned the policy of increasing food production in this country by means of legislation, to consider whether it is desirable that, in the alienation of Crown lands for agricultural purposes in the future, provision should be made that a definite proportion of each land so alienated be devoted entirely to the growing of food products."

The DIRECTOR OF AGRICULTURE read the Memorandum sent by the HON. DR. H. M. FERNANDO in support of his motion.

MUDALIYAR E. F. EDIRISINGHE seconded.

A discussion followed in which HIS EXCELLENCY THE GOVERNOR, and the following members took part :—Lieut.-Col. T. Y. Wright, the Hon. Mr. H. L De Mel, Messrs. W. Coombe, and W. A. de Silva, Hon. Mr. James Peiries, Lieut.-Col. T. G. Jayawardene and Director of Agriculture.

HIS EXCELLENCY THE GOVERNOR closed the discussion and suggested the postponement of the motion for reconsideration at the next meeting of the Board. This was agreed to.

Agenda Item 4.—Committee for Developments of Lands.

MR. W. A DE SILVA moved the following resolution :—

"That the appointment of an Advisory Committee to deal with the development of land, more particularly in the tank districts, is desirable."

In support of his motion he advocated the formation of an Advisory Board with the object of bringing a closer co-operation between the Forest Department, the Revenue Departments, the Irrigation Department, the Medical Department and the Department of Agriculture. He said if there was such a Board they could call for meetings from time to time and give advice to the cultivators in matters that should be dealt with by each Department and remove the serious difficulties that lie before the would-be cultivator.

HIS EXCELLENCY THE GOVERNOR offered certain remarks on the motion and said that he was quite opposed to the appointment of Committees and suggested that steps should be taken to bring together in conclave all the various Heads of Departments interested in lands which are to be offered for sale under tank areas. He stated that the question of forming a conclave of Heads of Departments would receive consideration without delay. MR. W. A. DE SILVA withdrew his motion in favour of the proposal put forward by HIS EXCELLENCY THE GOVERNOR.

Agenda Item 5.—Cotton Experiments.

The DIRECTOR OF AGRICULTURE speaking on the possibilities of a Cotton industry in Ceylon, referred to the successful experiments which had been conducted in Ambalantota and Kiula. He said that cotton could be grown well in the North-Western, Northern and Uva Provinces, if climatic conditions were favourable. He briefly reviewed the yields of the three varieties of cotton, viz., American Upland, Cambodia and Egyptian and stated that he had received an offer of Rs. 20/- per cwt. from the Colombo Spinning and Weaving Mills for the Cambodia cotton which had already been grown at Ambalantota. In concluding his remarks he said the question to be considered was whether Government could help them to foster the industry and he also put forward three suggestions which he thought would be useful ones, viz., (1) that Government might well issue seed free for the purpose of encouraging the planting of small experimental plots; (2) that the price for the cotton should be guaranteed and this could be done in view of the promise made by the Colombo Spinning and Weaving Mills; (3) that some arrangements be made to establish purchasing centres, where any cotton brought in could be purchased, paid for and sent to Colombo.

The DIRECTOR OF AGRICULTURE answered certain questions raised by LT.-COL. T. Y. WRIGHT and MUDALIYAR E. F. EDIRISINGHE.

The HON. MR. J. H. MEEDENIYA said that if Central Stations were established where the villagers could dispose of their cotton, its cultivation would quickly become popular. He said that the Magam Pattu Mudaliyar made a profit of from Rs. 50/- to 60/- on an acre on cotton grown in his district. He also gave results of cotton experiments conducted by him at Embilipitiya.

HIS EXCELLENCY THE GOVERNOR said that he was once the Governor of a cotton growing colony where he had seen large areas of cotton being grown by large estate owners and small cultivators. The people of the country found that it paid them extremely well and consequently they too were inclined to plant up all the land with cotton, to the detriment of foodstuffs, since they found that cotton paid them best. HIS EXCELLENCY stated that central markets were organized under Government supervision for the sale of cotton. The cultivators picked their cotton and at a certain time of the year they were notified to bring the cotton for sale to the Central Market, where a minimum price was fixed and the cotton put up for auction. The highest bidder, provided his bid was above the minimum price laid down, secured the lot. By this means the cotton industry of Nyasaland and Uganda Protectorates were established. HIS EXCELLENCY said that the offer of the Colombo Spinning and Weaving Mills to buy up all the cotton grown in the Island at fixed prices should result in the establishment of an important industry, which he was convinced would not clash with the planting of food products.

This closed the discussion on the subject.

Agenda Item 6.—Plant Pest and Disease Regulations.

The DIRECTOR OF AGRICULTURE, speaking on the motion, pointed out that the regulations under Plant Pests Ordinances No. 5 of 1901 and No. 6 of 1907 now in vogue (1) in regard to the fumigation of plants imported and (2) in regard to the control of the pests in the island needed revision and amendment. The first regulation does not allow the officer fumigating to use his discretion as to whether fumigation in some cases is actually necessary and as to whether destruction of any consignment of plants particularly harmful is advisable. The second regulation has made no provision in case of an emergency to deal with and to take prompt action in case of a serious outbreak of a pest without reference to a Plant Pest Board who in turn had to refer the matter to the old Committee of Agricultural Experiments. He intended to bring up the matter for discussion at the next meeting of the Board of Agriculture with the proposed amendments for consideration. In the meantime he would be glad if any member of the Board would communicate to him his views on the existing Ordinances and Regulations.

The meeting terminated at 4-30 p.m.

R. ALUWIHARE,

Secretary, Board of Agriculture.

MINUTES OF MEETING OF ESTATE PRODUCTS COMMITTEE.

Minutes of the 8th meeting of the Estate Products Committee of the Board o Agriculture held at the Victoria Commemoration Buildings, Kandy, at 10 a.m. on Thursday, May 11th, 1922.

Present :—The Director of Agriculture (Chairman), The Botanist and Mycologist, The Government Entomologist, The Government Agricultural Chemist, The Acting Assistant Entomologist, Messrs. H. D. Garrick, E. W. Keith, J. S. Patterson, George Brown, The Hon'ble Mr. James Peiries, Messrs. A. S. Long-Price, W. R. Matthew, A. W. Beven, Graham Pandittasekera, N. G. Campbell, Gate Mudaliyar A. E. Rajapakse, Lt.-Cols. L. Bayley, T. Y. Wright and T. G. Jayawardene and Mr. T. H. Holland, M. C. (Secretary).

As Visitors :—Messrs. E. C. Villiers, J. A. Coombe, George Marshall, and J. E. P. Rajapakse.

Letters and telegrams regretting the inability to attend were received from the Hon'ble the Controller of Revenue, Major J. W. Oldfield, O.B.E., M.C. ; Messrs. C. P. de Silva, R. Garnier and J. B. Coles.

The minutes of the last meeting having been circulated to members were taken as read and confirmed.

Agenda Item 1.—Progress Report of the Experiment Station, Peradeniya.

The CHAIRMAN remarked that good yields of sugar-cane were still being obtained from plant canes. The analyses of the juices were reported to be much better than last year. Full details would be published later.

The rubber experiments previously agreed upon by the Committee had been started with the exception that a block for daily tapping had not been included as after consultation with officers of the Department and in view of previous results it appeared that this would not afford further information.

MR. J. S. PATTERSON agreed with this view, but said that it would have been interesting to see if the trees tapped daily were more liable to Brown bast.

MR. GEORGE BROWN referring to the bushes which had died in the Tea manurial plots asked whether *Diplodia* or the hard pruning was considered to be the actual cause of death.

The CHAIRMAN replied that it was hard to say, the drought was also probably a contributory cause.

MR. PETCH was of the opinion that the hard pruning had probably added the finishing touch.

Agenda Item 2.—Cacao manurial Experiments, Peradeniya.

MR. M. KELWAY BAMBER reviewed the report which had been circulated to members. Referring to the "B" cacao experiments MR. KEITH remarked that there was only one experiment with Phosphoric acid and that estates were applying mixtures containing larger proportions of this element.

LT.-COL. T. G. JAYAWARDENE enquired how the difference between plots 1 and 11 and 2 and 12 which received similar treatment were accounted for.

The CHAIRMAN replied that the fact that Plot 1 was on the outside and exposed to the wind. This probably accounted for the inferiority in yield of this plot. Cacao would not tolerate wind.

Agenda Item 3.—Wattle Bark.

The CHAIRMAN read a letter from the Imperial Institute, London, which pointed out that the production of Wattle Bark in Ceylon might prove profitable on account of the present demand in London.

There was a factory in Natal which extracted the tannin from the bark and exported this. A good deal of Acacia was grown Up-country for fuel and it was worth consideration whether it would not pay to strip the bark from the trees before cutting them for fuel. Two estates to the CHAIRMAN's knowledge had sold wattle bark to a local tannery at prices corresponding with those now quoted from England.

In reply to a question from LT.-COL. T. Y. WRIGHT, MR. KELWAY BAMBER stated that analyses of Ceylon bark had been made some years ago, some samples had given good results but the results were very erratic. It was pointed out that on Tea estates the Acacias were usually cut before they were 4 years old.

The CHAIRMAN remarked that the heavy frieght as compared with that from South Africa had in the past placed Ceylon at a disadvantage.

Agenda Item 4.—Chilaw Coconut Experiments.

(a) *Consideration of results of Experiments up to end of 1921.*

The CHAIRMAN stated that the results had been in the hands of members for some time. He had also had the results prepared in graph form since 1917 from which year the copra outturn was available. These graphs were exhibited to members. When all the figures were analysed in detail the results which were indicated in the report were obtained.

The CHAIRMAN then reviewed the report.

The general conclusions in the report were now open for criticism and discussion. MR. J. S. PATTERSON asked what was the average number of nuts per candy. MR. BAMBER worked this out to 1290 which was considered high for the Chilaw district. MR. BAMBER stated that the soil of the plots was of two types but he thought there was a considerable area of similar soils in the district.

(b). *Consideration of the Report of the Sub-committee Appointed to Deal with these experiments.*

Following a discussion on the conditions of the lease of the land in question and of the methods of procedure adopted in carrying out the experiments, MR. BAMBER read and commented on the Sub-committee's report.

MR. J. S. PATTERSON suggested doubling the quantities of manure and applying them biannually. LT.-COL. T. Y. WRIGHT enquired how the manures were applied and on being informed that they were applied in trenches round the trees suggested that it might be better to apply them to the whole rows.

LT.-COL. T. G. JAYAWARDENE suggested a small permanent sub-committee whose members should visit these experiments at intervals.

The CHAIRMAN did not see that this would serve any useful purpose.

After some further discussion the question whether the experiments should be continued was put to the meeting. The majority of the Committee voted in favour of their continuance. The question as to whether the Sub-committee's report should be given effect to was then put to the meeting.

The majority voted in favour of giving effect to the report.

It was also agreed that plot No. 9 should be classed with plots 1 to 8 and that the future division of the plots should be 1 to 9 and 10 to 16 inclusive.

Agenda Item 5.—Results of Coconut Trials at Negombo and Jaela.

The CHAIRMAN said that GATE MUDALIYAR RAJAPAKSE carried out these experiments in the interests of the coconut industry and he would ask him to read his report taking the Negombo experiments first.

MUDALIYAR RAJAPAKSE then read and commented on the report of the Negombo experiments.

The CHAIRMAN enquired the age of the palms.

MUDALIYAR RAJAPAKSE replied that they were planted in 1912 and added that from this year the figures for oil extraction will also be available. In dealing with the area in which all the products of the trees less the oil were returned to the soil the CHAIRMAN remarked that the figures showed a slight falling off.

MUDALIYAR RAJAPAKSE agreed but said that drought was partly responsible and that some of the materials took a considerable time to decompose.

MUDALIYAR RAJAPAKSE said that owing to drought in 1921 the weight of materials returned to the soil was considerably reduced.

The CHAIRMAN said that this would affect the 1922 crop but not the 1921 crop.

In reply to a question from MR. PATTERSON, MUDALIYAR RAJAPAKSE said that the number of nuts per candy was larger than the average estate outturn in that district.

Experiments at Jaela.

MR J. E. P. RAJAPAKSE who is in charge of these experiments read a report and reviewed the objects and course of the experiments.

The CHAIRMAN said that there was no doubt that the unmanured and uncultivated plots had been making very little progress and a marked improvement had taken place since treatment had been given.

He proposed a hearty vote of thanks to MUDALIYAR RAJAPAKSE for carrying on these experiments in the interests of the industry.

This was carried with acclamation.

Agenda Item 6.—Pests of Coconuts.

The CHAIRMAN said that his object was to stimulate an interest in these pests. He had sent a circular to members about the coconut caterpillar in the Batticaloa district in order to get the schedule altered.

Cutting leaves was the only practical remedy that the Entomologist could advise at present. The pest had previously only made its appearance every 4 to 6 years but now annual outbreaks were taking place at Batticaloa. It was necessary to consider whether the parasitic control had changed. In

other coconut districts the pest was sporadic but in Batticaloa it had now become a very serious question and measures were necessary which might seem to some rather drastic. The Entomologist had gone carefully into the matter and would make some remarks. He had noticed many dead palms in coconut districts and it was a question whether the time to compel the clearing up and burning of these palms had not come.

DR. HUTSON then made some remarks about coconut pests. Commenting with the coconut caterpillar he said that this pest had been previously sporadic but was now chronic in the Batticaloa district. The caterpillars attacked the under side of the leaves and where a large number were present the leaves became riddled with galleries and died. On some estates in the Eastern Province two-thirds of the fronds were dead and only two or three leaves were left at the top of the trees. He exhibited photos showing trees in this state. In 1906 GREEN had investigated the pest and light traps were then in use on some estates. GREEN had decided that light traps were useful and that affected leaves should be cut off. In the early stages only a slight loss of leaves will result but in the advanced stages cutting of leaves becomes serious and leads to the fall of nuts and to younger nuts not coming on. Nothing much had been done since GREEN's investigations to endeavour to check the spread of the pest.

On well cultivated estates the pest generally took longer to become established and was more easily checked than on poorly cultivated estates.

The pest was declared in September 1921 but the cutting and burning of leaves was objected to by many cultivators and it was decided to make a trial with light traps.

In March 1922 light traps were only in use on a few estates. Small fires were general but did not attract or destroy a sufficient number of moths though a double purpose was served, if the fires were made with infested leaves. It has now been decided to amend the regulations and enforce the cutting and burning of leaves supplemented by the optional use of light traps,

The method was drastic and it remained to be seen how trees would stand it. Spraying was only practical on young trees and it was only of use to spray the underside of the leaves. In the Eastern Province the parasites which attacked the coconut caterpillar were themselves attacked by other parasites and could not therefore do their best in checking the pest. In the Western Province there was a small wasp which was the only important parasite and this insect was probably responsible for maintaining an efficient check upon the pest in that Province.

Turning to coconut beetles DR. HUTSON said that they had been on the increase during the last 1½ years. They were bad in the Eastern Province and quite serious in the Kandy district. The black beetle bred chiefly in old stumps and rubbish and did not do very serious damage itself except in young trees but by injuring the trees gave an entrance to the red weevil which could only enter through an injured portion. Control of the beetles consisted in clearing up and burning stumps and rubbish. The question was more serious in dry years.

MR. GEORGE BROWN referring to light traps asked if they were stationary or revolving. In the light of other experience it was necessary for the beam of light to actually strike the moth in its flight in order to attract it to the lamp.

The CHAIRMAN replied that the lamps used were open all round.

DR. HUTSON said that a powerful motor lamp had been experimented with but the moth merely remained in the beam particularly where it was focussed on any solid object and did not approach the lamp.

LIEUT.-COL. T. Y. WRIGHT asked if there was any particular season when the moths emerged.

DR. HUTSON replied that it was now practically continuous in the Eastern Province.

MUDALIYAR RAJAPAKSE said that the pest had appeared in 1914 in the Negombo district but that cutting and burning the leaves at the outset had easily checked the pest.

The Committee endorsed the decision to ask for the cutting and burning of affected leaves or portions thereof to be scheduled under the Ordinance.

Agenda Item 7.—Varieties of Coconuts.

The CHAIRMAN asked leave to postpone this item till the next meeting.

The meeting then terminated with a vote of thanks to the chair.

T. H. HOLLAND,
Secretary,
Estates Products Committee.

MINUTES OF A MEETING OF THE FOOD PRODUCTS COMMITTEE.

Minutes of a meeting of the Food Products Committee of the Board of Agriculture held at the Royal Botanic Gardens, Peradeniya, at 9 a.m., on May 12, 1922.

Present:—The Hon. Mr. F. A. Stockdale, Director of Agriculture, (Chairman), the Hon. Mr. C. C. Tillekeratne, the Hon. Mr. T. B. L. Moonemale, Mr. G. W. Sturgess, Government Veterinary Surgeon; Mr. P. B. Nugawela, Ratemahatmaya and Diyawadana Nilame; Mr. C. Drieberg, Mr. A. Sabapathy, Gate Mudaliyar L. A. Dassanayake, Gate Mudaliyar C. H. A. Samarakkody, Mudaliyar E. F. Edirisinghe, Mr. R. A. Senior White. Mr. A. A. Wickremasinghe, Mr. K. Bandara Beddewela, Mr. C. W. Bibile, Ratemahatmaya, Mr. S. Muttutamby, Mr. R. O. Iliffe, Economic Botanist, and Mr. N. Wickremaratne (Secretary).

Visitor.—The Hon. Mr. E. R. Tambimuttu.

Minutes of the meeting held on December 14th were confirmed.

Agenda Item 2.—Transport of Straw on the Railway.

The CHAIRMAN tabled the letter received from Government in reply to further representation as was resolved at the last meeting with regard to the reduction of rail freight on straw from Anuradhapura to Jaffna. It was intimated that it would be possible to reduce the rate if the straw is properly baled by press. He informed that he had already taken steps to secure a small baling press.

A discussion followed in which Messrs. A. SABAPATHY, G. W. STURGESS, R. A. SENIOR WHITE, C. DRIEBERG, E. R. TAMBIMUTTU, and the CHAIRMAN took part. MR. SABAPATHY dwelt on the present difficult position of the

question of cattle food in the Jaffna Peninsula and the increase of the importation of cattle to the Peninsula for agricultural purposes. He suggested that the Government should take the initiative in the matter of pressing straw as ordinarily the villager was slow to adopt innovations. MR. STURGESS made mention of a Canadian wooden press suitable for the purpose seen in Colombo sometime back and stated that American and Canadian types of presses should be investigated.

MR. DRIEBERG suggested Anuradhapura as a suitable centre for baling experiments.

The CHAIRMAN was quite in sympathy with the proposal and expressed his appreciation of MR. SABAPATHY'S intentions and agreed to start experiments with baling of straw by press at Anuradhapura.

Agenda Item 3.—Paddy Cultivation by Prison Labour.

The CHAIRMAN submitted a statement showing the nationality and previous occupation of the prisoners employed at the Experiment Station, Anuradhapura as was agreed to at the last meeting, and stated that the yields of the fields where the prisoners were employed have been 18, 22 and 23 bushels per acre per crop. A large number of prisoners who were employed has been included among those who were released on the occasion of the visit of H. R. H. THE PRINCE OF WALES.

The HON. MR. TILLEKERATNE asked for the reason for the production of these particulars and the CHAIRMAN explained.

MR. WICKREMASINGHE suggested that land should be set apart in the colonization scheme for them, and the CHAIRMAN remarked that this involves the question of finance.

MR. SENIOR WHITE asked whether the number of prisoners released was large, and the CHAIRMAN said that it was about 50%. He stated that he could secure figures.

MESSRS. E. F. EDIRISINGHE and T. B. L. MOONEMALE offered remarks.

The CHAIRMAN said that the experiments would be continued for another six months and that full details would be given at the end of the period. In the meantime he undertook to find out the number of released prisoners.

Agenda Item 4.—Irrigation Facilities for Paddy Cultivation.

A list of urgent irrigation works which were required for facilitating the cultivation of paddy in the interest of increase of food production was submitted by the CHAIRMAN who said that the list was supplied by the various Food Production Committees and asked for representatives of the local Committees to give their views on the question.

MESSRS. SENIOR WHITE, EDIRISINGHE, TAMBIMUTTU, TILLEKERATNE, SABAPATHY, DRIEBERG, NUGAWELA, BIBILE and the CHAIRMAN offered remarks.

MR. SENIOR WHITE spoke of the delay in undertaking the work that has already received sanction and money voted and mentioned the case of an irrigation work at Bowetenne in the Matale District.

MUDALIYAR EDIRISINGHE speaking on behalf of the Nuwara Eliya Food Production Committee said that there were 40 urgent works of which only four were selected so they were most urgent and important. He suggested as a means of expediting the works that there should be more

co-operation and co-ordination between the Departments interested in the work namely the Departments of Irrigation, Agriculture and Revenue. He advocated the division of the works to two classes. First, works which require the supervision of skilled engineers and second the smaller works which did not require the services of such skilled engineers. He advocated that the funds for minor works should be allocated by the Food Products Committee of the Board of Agriculture.

MR. SENIOR WHITE suggested the fixing of a limit of an expenditure of Rs. 50/- per acre on works that should be brought under the minor works.

The HON. MR. TILLEKERATNE speaking on behalf of the Matara Committee said that the Polatuganga flood outlet scheme first came for consideration in 1833 and if they were going to give first consideration to urgent works of irrigation they should also pay some regard to priority.

The HON. MR. TAMBIMUTTU suggested that the proposals should be referred to the Director of Irrigation for his remarks and then the matter be placed before the Committee at an early date so that the report may be sent to Government before the estimates are settled in June.

The CHAIRMAN agreed to adopt the suggestion and to call a meeting to be held in Colombo in June after receiving report from the Director of Irrigation.

MR. SABAPATHY urged the taking up of the minor works in the Mullaitivu District and MR. SENIOR WHITE asked that the wants of Matale should not be overlooked.

MUDALIYAR EDIRISINGHE pressed his motion with regard to the placing of the finances of smaller works in the hands of the CHAIRMAN of the Committee. The CHAIRMAN thought that caution in this matter would have to be exercised.

MR. DRIEBERG thought that the suggestion would carry the same effect if the finances remained in the same hands as they were at present but the disposal of it in the hands of the CHAIRMAN.

MUDALIYAR EDIRISINHE finally proposed "That the amount allocated by the Legislative Council for the minor irrigation works be expended on the recommendation of this Committee."

MR. SENIOR WHITE seconded and the resolution was unanimously carried.

The CHAIRMAN agreed to call for estimates from the Director of Irrigation and to refer back the lists to Food Production Committees for further reports and to call a meeting at end of June to be held at Colombo.

MUDALIYAR EDIRISINHE suggested the holding of next meeting in Jaffna and the CHAIRMAN said that he might consider this matter in connexion with later meetings.

Agenda Item 5.—Bunchy Top Plantain Disease.

A summarised report of the Government Agent, Western Province, on "Bunchy Top" Disease of Plantains in the Colombo and Kalutara District was tabled.

MR. WICKREMESINGHE wished to know what was the remedy for the disease.

The CHAIRMAN explained and reference was made to the Leaflet issued on the treatment of the disease. He asked the members whether they have observed any variety immune from the disease.

MR. WICKREMESINGHE said that the variety known as Embul hondarawala was once supposed to be immune from the disease but that this variety was now being attacked with the disease.

MR. SENIOR WHITE suggested the prohibition of the import of plants from the diseased areas to the Northern and Eastern Provinces.

The CHAIRMAN thought that the present situation is such that it was difficult to adopt such measures.

MR. NUGAWELA suggested the desirability of obtaining reports with regard to the disease from other districts as well and proposed that an Experiment Station be started at a plantain growing centre such as Rambukkana in order to carry out experiments.

The CHAIRMAN agreed to consider this suggestion.

MR. SABAPATHY and MR. BEDDEWELA related their experience how plantain plants brought from Jaffna and Polgahawela respectively and planted in Colombo were attacked with the disease.

MR. WICKREMARATNE said that his experience was that at first disease appeared among plants in poor soil but at present the disease spreads into new clearings and that the disease is virulent.

The CHAIRMAN explained that the application of potash was necessary for the good growth of the plants and the presence of potash in the new clearings was responsible for the absence of the disease in such lands and that if the disease is evident in the new clearings also as MR. WICKREMESINGHE indicated that was a matter which required investigations.

The HON. MR. MOONEMALE said that the disease is spreading to Galagedera district and that measures should be adopted to stop the spread of the disease.

GATE MUDALIYAR SAMARAKKODY offered to place 2 acres or more of land at Rambukkana at the disposal of the Chairman for Experiments for the control of the disease.

It was agreed to take necessary steps as regards the obtaining of reports on the prevalence of the disease in other districts, the prohibition of the import of plantain plants from the Western Province to North and Eastern Provinces and the starting of a control plot at Rambukkana.

Agenda Item 6.—Growing and Transplanting of Paddy.

In tabling the report of the Divisional Agricultural Officer, Northern, on the experiments with growing and transplanting of paddy crops at the Experiment Station, Anuradhapura, the Chairman referred to the experiments began by MR. SUMMERS, the late Economic Botanist at Anuradhapura with regard to the question of tillering and transplanting and that the experiments reported in the report have shown that transplanted paddy has given a yield of 25 per cent. over that of broadcast sowing. This he considered of very considerable interest as it gave increased yields and reduced the seed rate. He proposed to devise with the aid of MR. ILIFFE, the Economic Botanist, and the Manager of the Experiment Station, Anuradhapura, experiments

with drilling seed to ascertain whether in the Low country where transplanting is difficult drilling could be practised instead of broadcasting. It should also save the seed rate as in the Batticaloa district where the seed rate was 3½ bushels per acre.

MR. BEDDEWELA thought that the plots were too small to convince the villager of the benefit of transplanting and suggested larger areas.

The CHAIRMAN explained that the plots at Anuradhapura were not at present intended for demonstration plots but were experiment plots and when the experiments proved successful it was proposed to establish demonstration plots in various districts for the benefit of the village cultivator.

The HON. MR. TILLEKERATNE said that transplanting had recently been carried out at Matara and that at Matara Wellaboda Pattu it has been very successful.

MR. BIBILE suggested the requisition of a seed-drill from Poona.

It was agreed to obtain a seed-drill from India for experiments.

The meeting terminated at 11-30 a.m.

N. WICKREMARATNE,
Secretary,
Food Products Committee.

REPORT ON THE WORK OF THE BOARD OF AGRICULTURE DURING 1921.

Since the last meeting of the Board of Agriculture in Colombo in August, 1921, five meetings of the Estates Products Committee have been held and one meeting of the Food Products Committee. Arrangements for the second meeting of the Food Products Committee could not be done before this meeting and has been fixed for to-morrow morning.

Several important matters connected with Pests and Diseases have received consideration. The investigations into the methods of disinfecting tea seed at the Fumigatorium, Colombo, have been completed, and in view of the fact that the method cannot be relied upon absolutely to protect the tea industry of Ceylon from the leaf blister-blight of India, it was decided that the prohibition of the import of tea seed into Ceylon from India was essential. The shot-hole borer investigations have been continued—two bulletins giving the results of experiments with the burial of prunings and with the use of various manures are at present in the press. The regulations relating to the shot-hole borer pest have been amended upon the advice of the Estates Products Committee in order to remove some restrictions which were found in practice to be unnecessary. It is satisfactory to record that there is every indication that the shot-hole borer pest of tea is at

present generally on the decline. In but few districts do its ravages appear to be on the increase. The question of adding root diseases of rubber to the Pests and Disease schedule has also been considered. It was decided that no useful purpose would be served by such action. The nut-fall of coconuts has been discussed and the results of investigations made during the year considered. The details of these investigations are at present in the press.

The coconut caterpillar is causing considerable damage in certain areas of the Batticaloa district and will have to be dealt with by the Plant Pest Board if its ravages are to be controlled. Work on the Bunchy Top disease of plantains is being continued and leaflets on this disease in the vernaculars have been prepared and distributed.

The results of the various experiments carried out by the Department of Agriculture upon its Experiment Stations have all been presented to the Committees of the Board at the completion of the year. These have included manurial experiments with tea, rubber, cacao, and coconuts, tapping experiments with rubber and the individual yield of rubber trees. The detailed results of the individual yield experiments have been carefully analysed, barks of individual trees have been examined, girth measurements taken and prepared for publication in bulletin form. The question of budding of rubber has also been considered and analyses of soils under rubber began in order to ascertain if there has been improvement or deterioration.

The Food Products Committee has considered the question of fodder supply to the Jaffna Peninsula and as the result of these considerations it has been decided to make experimental baling of paddy straw. The railway will provide for "pressed-straw rates" and it has to be ascertained whether the pressing of paddy straw cannot be encouraged to the benefit of the paddy cultivation of districts where there is at present little or no demand for the straw. The results of paddy manurial experiments have been presented to the Food Products Committee and the policy to be decided upon for the continuation of these experiments and for the encouragement of agricultural competitions amongst small owners discussed.

The work of the Economic Botanist upon the improvement of paddy varieties by selection has been discussed and the work done by prisoners in the cultivation of paddy at the Anuradhapura Experimental station considered. Analyses of a large number of paddy soils of Ceylon have been made and compared with analyses of paddy soils of other countries in the East. These are now ready for publication and will be presented for consideration in due course.

F. A. STOCKDALE,
Director of Agriculture.

May 8, 1922.

PROGRESS REPORT OF THE EXPERIMENT STATION, PERADENIYA.

For March and April, 1922.

TEA.

All the plots under experiment have been tipped and are in bearing. The recovery from pruning has been slow. A further number of bushes have died since pruning and have been dug out. In the Control plot (Assam Hybrid) 50 bushes have died, the average number in the Single plots was 19 per plot and in the Manipuri 8 per plot. *Diplodia* has been largely responsible for these losses. The manures were applied as per programme after the first rains in April.

A small area badly affected with Cora grass is being scraped weekly as an experiment.

RUBBER.

Tapping of the Avenue rubber under manurial experiment commenced on April 1st.

(1). New 2 versus 3-day tapping trials (cuts in 3-day tapping starting at 2/3 height of 2-day tapping).

(2). Tapping of trees planted in clumps and trees planted in Avenues half the trees in each case being tapped with a V cut.

(3). Alternate days versus alternate months tapping experiments.

CACAO.

Pruning and lopping of shade was completed in April. The manurial experiments with the exception of "B" cacao area terminated on March 31st. The total crop of dry cacao for the year was 217 3 cwt. = 4·87 cwt. per acre. The previous season's crop was 152·2 cwt. = 3·46 cwt. per acre. The crops from the different plots will still be gathered separately.

COFFEE.

Diebacks are now being removed and burned fortnightly. Seed of *Marago pipe* coffee has been obtained from South India for the Economic collection.

The Kent's Arabica coffee has germinated well and Jackson's Hybrid fairly well.

SUGAR-CANE.

The following calculated yields per acre were obtained from canes 17 and 18 months old harvested in March and April, 1922.

Variety.	Tons per acre.
D. K. 74	42·7
Sin Nombre	38·9
Red Top Mauritius	32·1
3390	22·4
Striped White Tanna	20·1
*Sealy's seedling	18·2
†Barbados 203	13·8
Average	26·8 Tons.

*There were many gaps in this variety owing to lack of sets at the time of supplying.

†Signs of fairly extensive thefts were found in this plot. Without these varieties the average yield is 31·5 tons per acre.

In the case of the following varieties majority of the canes were cut in August 1921. The yields are not therefore strictly comparable.

Variety.	Tons per acre.
Striped White Tanna	30·5
1237	21·7
55 P	15·7
131 P	12·0
Average ...	19·9 Tons

A small germination test was carried out with sets of these old canes.

Sets of varieties 1237, Striped White Tanna and 55 P were planted at intervals of 10 days, the canes being 16 months old at the first planted, each set containing 3 eyes. The results are shown below :—

Variety	No. of sets put in at each planting	Total sets planted	No. and shoots survived from				Total
			1st Planting	2nd Planting	3rd Planting	4th Planting	
1237	13	52	5	1	Nil	Nil	6
Striped white Tanna	13	52	32	16	8	4	60
55 P	13	52	22	14	2	1	39
Total...	39	156	59	31	10	5	105

After the first planting a well distributed rain fell for 4 days while mainly dry weather prevailed after the other plantings. The sets were however regularly watered. It will be seen that although the germination of the 3 varieties showed great variation and the whole results were poor there was a regular and marked decline in germination with sets from canes of increasd age.

TUBERS.

A small experiment has been started in planting whole manioc cuttings upright attached to a stake as opposed to the ordinary method. Though more cuttings are needed an experimentor in Trinidad claims to have obtained tubers in three months by this method against a normal period of 6 months.

GENERAL.

Decorations and other preparations for HIS ROYAL HIGHNESS THE PRINCE OF WALES' visit absorbed labour during March and works are somewhat in arrears in consequence.

The weather has been very dry.

Rainfall for March was 1·05 inches and for April 6·57 inches.

T. H. HOLLAND,

Manager, Experiment Station.

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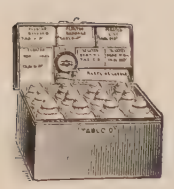

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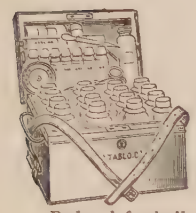

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AGRICULTURAL EDUCATION.

SCHOOL GARDENS COMPETITION.

Lieut.-Col. Wright's Competition for School Gardens in the North-Western Province.

In March, 1921, LT.-COL. WRIGHT offered the Director of Agriculture Rs. 100.00 for competition amongst the school gardens of the North-Western Province with a view to encouraging teachers in the improvement of their school gardens and in the cultivation of vegetables and foodstuffs. It was decided to offer prizes as follows:—

KURUNEGALA DISTRICT. *First Prize valued Rs. 50.00.*

Second Prize valued Rs. 25.00.

PUTTLAM-CHILAW DISTRICT. *First Prize valued Rs. 25.00*

Thirty-five gardens in the Kurunegala District and nine in the PUTTALAM-CHILAW district entered for the competition. These gardens have all been inspected by MR. K. S. ARUMUGAM, Agricultural Officer, Kurunegala, with

the following results:

KURUNEGALA.	*First Prize*.....*Kankaniyamulla*...	*M. S. V. 269.*	*marks.*
	Second Prize.....*Medamulla* ...	*B. V. S. 229.*	*marks*
PUTTALAM-CHILAW.	*First Prize*.....*Walpaluwa* ...	*B. V. S. 181.*	*marks.*

The full report of MR. ARUMUGAM is as follows:—

"Thirty-five school gardens in the Kurunegala District and nine in the Chilaw-Puttalam District have competed for the above mentioned prizes.

Forty-three varieties of vegetables, including currystuffs, were cultivated in the various school gardens which have competed for this prize.

A question was raised whether currystuffs should be included in the list of vegetables. After giving due consideration to this question, I have included them in the list.

English vegetables.—Cabbage (leafy kind), radish, tomatos, spinach, and salad have been cultivated with great success in most of the school gardens. None of the schools in Chilaw and Puttalam Districts has tried cabbage. Only five schools, situated in the drier parts of Kurunegala District, have planted potatos, and the crop is fair.

Indian vegetables and currystuffs —Coriander, anise, cumin and turmeric were cultivated in a few school gardens with partial success, while dhall was grown in many of them. Kankaniyamulle has introduced gram and pepper. Gram grew very well there.

Indigenous vegetables.—Both the teachers and the students of all the schools are convinced that the cultivation of onions is profitable. Red onions, white onions and Bombay onions were grown in all the school gardens. In most of the school gardens this crop was re-planted as soon as the harvesting of the previous crop was over. Brinjals, chillies, lady's fingers, snake gourd and ridge gourd are the most common vegetables. In each school garden different kinds of these vegetables were grown. Best kind of bitter gourd was produced by Mahannerriya school garden only.

Best Vegetables Produced.

Mahananneriya *S. G.* has produced the best bitter gourd.

Awlegama *S. G.*	tomatos
Kankaniyamulla	(cow peas)
Bandara-Koswatta	ash pumpkin and cabbage.
Hettipola	cabbage.
Mahananneriya	knolkhol and cabbage.

Kankaniyamulla S. G. has distinguished itself not only by growing a greater number of varieties of vegetables but also by cultivating many kinds of each variety.

Medamulla S. G. has won the second prize by being good all round. Many varieties of vegetables and different kinds of each variety were cultivated. Cultivation was satisfactory.

Cultivation in general was satisfactory but it can be improved. The beds were well prepared and manured. No artificial manure was used. Mulching was not done in most of the School Gardens.

In judging the cultivation of vegetables in various school gardens, though allowance was made for conditions of climate, soil, manure, water, etc., still it was found necessary to assign some marks to soil, water, manure, cultivation, and to kinds and miscellaneous crops.

Soil. Number of marks... .....10.

Marks are assigned according to physical character of the soil, its depth, fertility and its capacity for holding soil moisture.

(1) Very sandy soil, containing big particles of sand is assigned 8 marks e.g., Mahakumbukkadawala school garden.

(2) Very sandy soil, subjected to cultivation for a long period, is assigned 10 marks, e.g. Makandura school garden.

(3) Shallow soil, situated on the slope of a hill, cannot retain soil moisture, is given 10 marks e.g. Wadakoda school garden.

Water. Marks are assigned according to the depth of water, its proximity to the garden, and the amount of energy required to carry it to the plots. Highest marks are assigned to conditions requiring the greatest amount of energy to be spent.

Manure. Quantity of manure available in the locality, and the amount of labour and time required for transporting same to the garden are taken into consideration.

Cultivation. Skill in cultivation, mulching, formation of beds, etc., are taken into consideration.

Miscellaneous crops and kinds. Gardens which have cultivated many varieties of fruits, food crops, yams, medicinal plants, and ornamental plants could not find sufficient space to cultivate many kinds of each variety of vegetable. As such gardens too should receive some consideration, 10 marks have been assigned to this item. The total marks were as follows :—

Kurunegala District.

Order of Merit.	Name of school.	No. of marks.
1.	Kankaniyamulla M. V. S.	269
2.	Medamulla	229
3.	Boyagane	201
4.	Awlegama	194
5.	Makandura	179
6.	Mahananneriya	175
7.	Hettipola	165
8.	Weuda	152
9.	Gonigoda	149
10.	Balalla	142
11.	Wariyapola	141
12.	Buluwela	136
13.	Hunupola	134
14	Nakkawatta	133
15.	Atamune	131
	Itanawatta	131
16.	Bandara-koswatta	126
17.	Giriulla	123
18.	Watareka	122
19.	Kirindewa	121

	Madagalla	121
20.	Meddegama	119
21.	Moragane	115
22.	Kudakatnoruwa	114
23.	Wadakada	113
24.	Polpitigama	112
25.	Diulwewa	110
26.	Ehetuwewa B. V. S.	105
27.	Poromadulla	83
28.	Digalla	81
	Konwewa	81
	Ehetuwewa G. V. S.	81
29.	Monnekulama	72
30.	Nettipolagedera	65
31.	Horatepola	44

Chilaw and Puttalam.

Order of Merit.	Name of school.	No. of marks.
1.	Walpaluwa	181
2.	Anamaduwa	158
3.	Ihalapuliyankulama	126
4.	Walahapitiya	113
5.	Mahakumbukkadawala	104.
6.	Kelegama	95
7.	Etiyawela	66
8.	Nattandiya	62
9.	Maiyawa	28

LESSONS IN MAIZE GROWING.

For six years maize-growing competitions have been carried out for lads in the Transvaal, with most encouraging results, for the benefit derived from these competitions is not confined to those only who participate in them. It extends also to neighbouring farmers who obtain practical demonstration of the value of sound methods of cultivation, and are induced to put them into practice on their own farms ; the younger generation also are stimulated by the interest in the rural schools that these competitions engender. And that there is room for much improvement in the methods employed in the cultivation of our staple crop is evident from the low average yield of maize in the Union. Climatic conditions during the year over a large area of the Transvaal were not as favourable for maize as could have been wished, yet some of the competitors obtained as much as 15 bags per acre. The average yields per acre were 6½ bags in the low veld, 5 in the high veld, and 3½ in the middle veld. There were 50 lads who actually competed in the 1920-21 competition, and in view of the excellent results that must arise from them, it is trusted that competitions of this nature will grow in popularity. Their worth is recognised in other countries, where their beneficial influence is known to be widespread. A general extension of the movement in South Africa would be of speedy value to farmers of to-day, and establish a heritage of surpassing value to those who will follow them.—JOURN. OF DEPT. OF AGRIC., UNION OF SOUTH AFRICA, VOL. IV., No. 3.

PESTS AND DISEASES.

PESTS ON TEA AND COCONUTS.

The following extracts on more important pests which have been reported during the first quarter of 1922 have been taken from the Progress Report of the Entomologist for the period :—

TEA.

The reports of the Plant Pests Inspector, Southern, indicate that *Helopeltis* has been prevalent on several estates in the Southern Division. This pest has also been reported from Dolosbage.

Outbreaks of caterpillar pests include Tea Tortrix (*Homona coffearia*), Red Slug (*Heterusia cingula*), Fringed Nettle Grub (*Natada nararia*), Bag worms (*Acanthopsyche hypoleuca*), and Faggot worms (*Chalia doubledayi*). A record of interest is the occurrence of the large stem-boring and bark-eating caterpillar (*Phassus purpurascens*) on an up-country estate in a small area of tea which had been rested for the past four years. This species was recorded by RUTHERFORD as attacking *Cinchona succirubra* in Ceylon, but we have no previous record of its being a pest of tea. It is probable, however, that this caterpillar is by no means a stranger to tea in Ceylon, and that the injury done by it has been attributed to the Red Borer (*Zeuzera coffeae*) or to the bark-eating borer (*Arabela quadrinotata*). This *Phassus* borer not only tunnels in the branches, but eats away portions of the bark under cover of a webbed gallery covered with frass. A related species, *Phassus malabaricus* is known to bore into the roots of tea bushes in India.

An outbreak of the small grey weevil (*Myllocerus curvicornis*) was reported from one up-country estate. These weevils eat notches out of the edges of tea leaves giving the bushes a ragged appearance. Dadaps are similarly affected.

Tea mites have also been reported from several estates, the more common species being the small red-spider or scarlet mite (*Tenuipalpus obovatus*) and the yellow mite (*Tarsonemus translucens*).

COCONUTS.

The Coconut Caterpillar (*Nephantis serinopa*) has been seriously prevalent on several estates South of Batticaloa for several months, and recent reports indicate that it is increasing on some estates to the north of Batticaloa. Outbreaks of this pest have occurred recently in the North-Western and Southern Provinces.

A leaflet on this caterpillar will be published shortly, giving the latest information as to the habits and life history of the pest and the measures which must be adopted for its control.

The Black Beetle (*Oryctes rhinoceros*) and the red Weevil (*Rhynchophorus ferrugineus*) have been unusually prevalent in some districts during the past few months. The Black Beetle has been particularly abundant and this is not surprising when one takes into account the vast number of breeding places for this pest which exist in almost every place where coconuts and other palms grow in Ceylon.

The collection and destruction of the beetles will be an endless task unless steps are taken to eradicate the breeding places of the grubs. The destruction by fire of all old hollow and decaying palm stumps, fallen logs and dead palms, and the breaking up of all heaps of decaying vegetable matter, such as animal manure, rotting coconut refuse, etc., will go a long way towards reducing the numbers of the Black Beetle. The reduction in the numbers of the Beetle will mean fewer injured palms, and incidentally will mean fewer Red Weevils, since the weevil breeds mainly in palms already injured by the Black Beetle.

COMMON NAMES OF USEFUL CHEMICALS.

It sometimes happens that a chemical name is given to some commodity that the farmer is advised to purchase. Under its imposing title he wonders what it is, but really the substance is perfectly well known to him by its "common" name. Nobody goes to the paint shop and asks for two-pennyworth of sodium chloride when he wants common salt, and most of us have learnt that methylated spirits are pure alcohol with 10 per cent. poisonous methylated or wood spirit added for commercial purposes and to protect the revenue. Still there are many other common substances which are veiled under scientific names. Here are a few:—

Common Names.		*Chemical Names.*
Alum	...	Potassium aluminium sulphate
Ammonia	...	Ammonium hydrate
Baking soda	...	Hydrogen sodium carbonate
Bluestone	...	Copper sulphate
Borax	...	Sodium biborate
British gum	...	Dextrin
Carbolic acid	...	Phenol
Caustic soda	...	Sodium hydroxide
Chalk	...	Calcium carbonate
Chloride of lime	...	Calcium chloride and hypochlorite
Common salt	...	Sodium chloride
Cream of tartar	...	Potassium tartrate
Epsom salts	...	Magnesium sulphate
Glycerine	...	Glycerol
Laughing gas	...	Nitrous oxide
Litharge	...	Lead oxide
Liver of sulphur	...	Potassium sulphide
Oil of vitriol	...	Sulphuric acid
Pearlash	...	Potassium carbonate
Slaked lime	...	Calcium hydroxide
Spirits of salts	...	Hydrochloric or muriatic acid
Stone lime	...	Calcium carbonate
Sugar of lead	...	Lead acetate
Sulphate of ammonia	...	Ammonium sulphate
Verdigris	...	Basic copper acetate
Vinegar	...	Acetic acid
Washing soda	..	Sodium carbonate
White lead	...	Basic lead carbonate
White vitriol	...	Zinc sulphate

APICULTURE.

BEE-KEEPING NOTES.

The fact that orange blossoms produce nectar in large quantities is not sufficiently recognised by bee-keepers. In California, when weather conditions are favourable, nectar is so abundant on the blossoms that the men working under the orange trees often find their clothes sticky owing to the nectar that has dropped on them when the branches are shaken. The potential power of the orange as a honey secreter must not be lost sight of by local beekeepers, and colonies must be kept strong to take advantage of the orange honey-flow. According to GLEANINGS IN BEE CULTURE an average colony output of honey in California varies from 40 to 250 lb. (chiefly from orange flowers) according to the character of the flow and the skill of the bee-keeper.

The President of the Ceylon Bee-keepers' Association (THE HON'BLE MR. STOCKDALE), writing to the Secretary, states that it has been represented to him that a single-walled hive would be quite sufficient for a place like Ceylon, and prove less expensive. The question is being submitted to leading bee-keepers for their views.

The ideal of a perfect comb especially for the brood chamber is one of the great aims of bee-keeping. So far the invention of comb-foundation stands out as the most important single step in this direction, and yet, as we all know, this does not always result in the production of perfect combs. Both of the aluminium comb and so-called "semi-comb" are creating great interest at present, but it would be as well to try these only on a small scale, and wait for further developments. MR. H. H. ROOT of the well-known house of "A. I. ROOT" makes a plea for wood-base foundation, which is said to give good results. With the keen interest that is being taken in the solution of this problem, it may be expected that before long we shall reach what is practically the acme of perfection. It may be mentioned that wire-cloth, celluloid, paper and Bristol board and Bakelite were all found unsuitable.

The latest and most popular of bee pastures is Huban clover, for which extraordinary properties are claimed. From British Colombia comes a report that it "makes growth of 31 inches in 21 days." Bee-masters are said to look upon the plant as an ideal means of improving and prolonging the honey-flow. Being also an excellent fodder and soil renovator, it is likely to be extensively grown wherever found suitable. The Ceylon Bee-keepers' Association has written for a small quantity of seed, which will be distributed among its members, with a view to giving a trial to this much-lauded honey plant.

MR M. SHANKS, one of the pioneers of bee-keeping in the Island, writes :—"I am as much interested in bee-keeping as ever, and have now more time to devote to it. I have 20 hives of "Me-messas" (*Apis indica*). I find that the "Kanaya" or dammer bee causes a lot of trouble to weak colonies of Me-messas, by entering the hives and smearing the inside with resinous matter. I have sometimes seen about 10 dammer bees going for a Me-messa bee, and dragging it out of the hive; and have had to shut up two of my small colonies to save them from these intruders. I should like to know whether anyone else has had trouble of this description ; I have,

however, encouraged the dammer bee to build in a box and found the honey quite good.

"Last honey season I had 4 hives of Me-messas working in one super and they did splendidly. I secured 16 bottles (of 26 oz. each) of honey from them, and had two large swarms. The frames I use are $13\frac{1}{2}'' \times 5''$. I have hives to hold from 5 to 12 frames and two to hold 16 : but consider the 12 frame hive the most convenient and satisfactory. During the season, when there is some honey (not too much) coming in, a good queen will keep 9 frames pretty well filled with eggs and brood. I took some 30 bottles of honey from 9 hives, though with a proper extractor I should have got a great deal more."

The notes received from MR. SHANKS, detailing his experience of bee-keeping in Ceylon, are particularly interesting; and the Secretary, Ceylon Bee-keepers' Association will be glad if members of the Association, and others who keep bees, will follow MR. SHANKS' example and furnish him with notes embodying their own experience.

C. D.

TO TRANSFER BEES FROM OLD HIVES TO NEW.

W. A. GOODACRE, *Senior Apiary Inspector.*

So unsystematically do some people commence bee-keeping that by the time they have decided that it is an occupation worthy of serious application, their stock is housed in hives of all shapes and sizes. Bee-keeping, on even the most modest scale, should be commenced with good hives of modern standard type. The transfer of bees from old hives to those of standard pattern may be effected as follows :—

For each hiveful of bees to be transferred, prepare a standard hive body, complete with frames, and standard-sized bottom board. All the frames, with the exception of one in each body, should be wired, and contain sheets (preferably full ones) of comb foundation. Find and cage the queen from the old hive, cut out a selected comb of brood from one of the frames, and fit it neatly into the unwired frame from one of the new bodies, making it secure with string fastened right round the frame, and place the frame of brood in the new body toward the centre. Remove the old body from its stand, and substitute the new hive body with its bottom board, but no cover. Place a queen excluder over the new body, fit over this the old hive, minus its bottom board, and finally liberate the queen at the entrance to the new hive.

The object of the foregoing procedure is to get the queen established in the body of the new hive, and to allow the brood in the old hive to emerge and keep up the strength of the colony. The queen will, of course, be unable to re-enter the old hive because of the excluder. Nine days after the transference, the old hive on top of the excluder should be examined, and any queen cells destroyed. In twenty-one days all the brood in the old hive will have emerged, and the apiarist can remove the excluder and the old hive and replace them with standard supers.

Transferring work should be carried out during warm weather while a honey flow is on, and preferably during the early summer, but if the autumn prospects for bees are good, early February is not too late.—AGRIC. GAZ., N.S.W., VOL. XXXIII, PART 2.

GENERAL.

THE PAPAW (CARICA PAPAYA).

W. MOLEGODE,

Agricultural Instructor.

Few of the cultivated Tropical Fruit Trees are so common in Ceylon as the Papaw or Papaya which produces one of the most wholesome and popular fruits obtainable almost anywhere in the colony throughout the year. The papaw is easily grown and begins to produce a crop in less than a year.* It is commonly met in a semi-wild state yielding an abundant crop. Few, if any, native gardens are lacking in a few papaw trees and rarely, if ever, have they been planted. Most of the papaw trees found are self grown. Till a few years back more enterprising villagers near towns cultivated papaws for the market, but now in certain areas in Kegalle, Matale, Kandy, Kurunegala, Galagedera, the papaw is largely cultivated for the latex which produces the papain of commerce and there are signs that papaw cultivation for this purpose is extending in the Island.

The papaw is a large succulent herb belonging to the natural order Passifloraceæ. It is supposed to be a native of tropical South America and the West Indies and is believed to have been introduced into the Island early in the XVIIth century. The tree seldom exceeds 20 feet in height. It is polygamous, that is male, female and hermaphrodite flowers are formed on the same or distinct trees. Trees bearing only the 'male' flowers are not productive. The hermaphrodite flowers yield the best fruits, oblong in shape, while the more roundish fruits are recognised to be the result of female flowers.

USES.

The fruit of the papaw is very largely used as a vegetable and as a dessert. It is well-known that tough meat if rubbed with the papaw juice or covered in the leaves or cooked with a green fruit becomes tender. It is even supposed that flesh of animals fed on the leaves and fruits become tender. The papaw fruit is considered a valuable remedy in cases of dyspepsia. The green fruit is a recognised wholesome vegetable. It is cooked in a variety of ways, and may be boiled and served with melted butter as a side dish or salad. The ripe fruit is one of the most favourite desserts in the Island Hotels and, but for the plaintain, is the only 'dessert' availble during the greater part of the year. The ripe fruit is also served in the form of many a tempting dish but it is best taken by itself when properly ripe, never too ripe, and if one likes with a dash of sugar or salt. Owing to the vegetable pepsin (papain) in it it has the effect of helping in the assimilation of all food with which it is eaten, hence it is considered by some a specific for dyspepsia. An excellent sauce is also made from the ripe fruit.

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* At Katugastota the writer put seeds in nursery on 20th March last year, young seedlings were transplanted early in May. In January this year trees 6 to 8 feet were bearing fruits and are heavily bearing now.

VARIETIES.

Numerous species of *Carica* are on record. There are only two varieties worth our attention viz., the ordinary papaw (*Carica papaya*) and the Mountain papaw (*C. cardamarcensis*). The latter though introduced as recently as 1880, has become a very common high elevation fruit and has become thoroughly acclimatised in the Nuwara Eliya district where it is frequently found growing even in a wild state. The fruit of the mountain papaw is much smaller in size to the ordinary papaw, pearshaped and ridged and is less favoured as a dessert. The papaw (*C. papaya*) has by cross-fertilisation produced numerous forms, but only differing in size of fruit and flavour.

CULTIVATION.

The papaw does best between sea level and 3,000 ft. elevation, coming to maturity earlier and producing fruits of a better flavour in the lower elevations. It prefers a warm and humid climate and, being rather sensitive to stagnant water and clayey soils, likes a well drained loamy or sandy soil with proportion of humus. The tree being composed of soft spongy wood is liable to be easily injured by strong winds and should therefore be protected from heavy blowing. Under favourable conditions a papaw tree will fruit in 10 to 12 months and continue to bear, sometimes as many as 100 fruits in different stages of growth being found on the tree, for three or four years and often longer. But as the tree grows beyond the 5th year it not only become difficult to gather the fruits but they come smaller and inferior in quality, so that if a plantation is to be kept up it is advisable to interplant every year. A point to bear in mind is that as soon as it is discovered that a tree is only bearing 'male' flowers it must be removed and another planted.

Old trees can be rejuvenated by cutting off the trunk about 2½ or 3 feet above the ground. A number of buds will soon sprout from the stump of which only two or three should be allowed to develop, and in a short time the stump will have become transformed into a full bearing tree.

PROPAGATION.

The papaw is propagated entirely from its seed. Fresh seed should germinate in 10 to 15 days. The seed beds should be well prepared, the soil thoroughly dug, freed of all weeds and well broken up. On this soil sow seeds about 6 inches apart and cover them up. The bed should be well watered. Shade should be provided both from sun and rain. Seeds can also be sown straight away in holes prepared for them. The village method of growing papaw is to cut down the jungle growth, allow it to dry and then sow the papaw seed broadcast and set fire to the dried jungle. The burning of the seed coating is believed to hasten germination.

TRANSPLANTING.

When the nursery plants are 4 to 6 inches high (there is no harm even if they are 10 to 12 inches), they may be transplanted in the field. A dull-moist-day is the best for planting out. If there had been no rain it will be necessary to thoroughly water the nursery beds before the plants are lifted up. In removing the plants from the beds take them up with a ball of earth. Do not plant any deeper than the plants were in the nursery. Shade the plants and water them when necessary. In order to reduce the evaporation of water from the young plants it is advisable to trim off three-fourths

the leaf blades. If larger plants are transplanted it is very necessary that all except the young buds and tender leaf blades should be removed and such plants should never be transplanted during excessive rains.

Transplant in holes 1½ by 1½ feet filled up with a mixture of well decomposed manure, humus and sand. The distance at which papaw should be put down depends on the nature and fertility of the land. 10 by 10 feet for ordinary soils, varying to 15 by 15 for fertile land.

AFTER CULTIVATION.

Papaw being a quick growing plant requires more water than most other plants, and should therefore get water as often as necessary. Keep the weeds down and work the soil round the plants, but do not injure the roots. A good mulch round the plants will do a lot of good. No further attention is necessary.

As stated before, the trees will begin to bear in about a year. For the purpose of a dessert fruit the fruits should not be plucked till they are ripe.

The papaw is a large, green fleshy fruit of different shapes. In some varieties the fruits are almost round like a ball and generally contain a large hollow cavity inside with the seeds attached to the placenta covering the edible pulp. In some varieties the fruits are oblong and oval and may be 10 to 12 inches long. Some fruits contain a large quantity of seeds cramped together in the hollow cavity in the centre of the fruit. Some fruits are almost seedless. A well developed fruit may weigh 6 or 7 lb.

The edible pulp in the fully ripe fruit is soft and should be of a yellow colour. Practically the whole fruit except for the seed cavity and the thin skin contains flesh which is edible.

A well grown tree will produce anything between 50 to 100 fruits a year and they sell between 10 to 20 cts. a fruit. The papaw has the disadvantage of being easily damaged when ripe owing to its softness and consequently marketing is a difficult problem.

SEED.

Seed should be taken from the best fruits. The best does not mean the largest but those that are sweet and well flavoured with small seed cavities and few seeds. Oblong fruits are generally preferred for seed purpose as the most likely to produce the true type. The seed should be gently dried in the sun and may be kept pretty long if mixed in ash.

About 3,500 fresh and 4,500 moderately dried seeds go to a pound.

PAPAIN.

Only matured but not ripe fruits should be tapped for the latex. The best 'tapping knife' is a sharp edged piece of bamboo with which the rind of the fruit is cut from end to end. Steel knives are never used. A sharp piece of ivory, bone or glass may be used. The juice is collected in porcelain cups or earthen ware hung below the tapped fruits. The latex coagulates rapidly and naturally. In Ceylon for several years the papain industry was in the hands of villagers and no systematic tapping, collecting and curing was practised. Sun drying was the only method adopted. Under the strong sun the latex would be sufficiently dry in a day or two and if fresh earthen vessels are employed it will help rapid drying because the vessels will absorb the moisture. In wet weather sun drying is a difficult problem. Long exposure to air and light and smoke drying spoils the colour of the papain. In wet weather rapid drying in a hot air chamber will produce the best coloured papain.

YIELD OF PAPAIN.

The Ceylon hybrid papaw is most favoured as the best yielding variety. It is estimated that 1 lb. of latex can be obtained from about 35 average sized fruits at one tapping. The climatic condition and bearing capacity of trees have a great bearing on the output of latex.

SELECTION OF CASTOR SEED.

The importance of all oils has been greatly emphasized during the late war. Of all vegetable oils castor oil is perhaps the one the demand for which is most likely to increase. Originally used as an illuminant in the days before the introduction of the mineral oils, its use has completely changed to that of one of the most valuable lubricants known. Attempts have therefore been made in India to determine whether by chemical selection it is possible to improve the race of castor from the point of view of its oil-yielding properties. The work is described in *Bulletin 117*, Agricultural Institute, Pusa.

The main difficulty in the way of such a selection appeared to lie in the fact that the castor plant, with its separate male and female flowers, was much more likely to be subject to cross-fertilization than a plant whose flowers were hermaphrodite. In consequence the investigation, although it had appealed to the writer for many years, was left alone, as being probably of only academic value. In 1918, however, an article appeared in the JOURNAL OF HEREDITY (Vol. IX, (1918), p. 198) in which it was stated that, contrary to expectation, castor plants grown in America had not been found very subject to cross-fertilization. In consequence an attempt was made to survey the different types obtained from various parts of Bihar. A number of types were sent in by different district inspectors, and were examined for oil-content in the writer's laboratory after drying. Remarkable differences in oil content on seed were observed from these different types of which seventy-five were isolated from seed characters, by courtesy of the Assistant Economic Botanist, MR. A. C. GHOSH. This oil-content as estimated by ether extraction, varied from as low as 21·8 per cent. to as high as 58·8 per cent. on the whole seed. Such differences appeared very striking, and selections were made and planted of seeds of very low and of very high oil-content. Of the 'low' collections, no type had an oil-content of more than 40 per cent., and the average of fourteen selections was 32·9 per cent. oil on seed. Of the 'high' collections, no type contained under 50 per cent. of oil, and the average oil-content of thirteen selections was 52·8 per cent. These types on growing were found to be very impure. This was only to be expected as the crops have never been grown with any attempt to keep different varieties separate. It was, however, to be expected that the first generations of plants from seed with oil-content as widely varying as the above, would also, on the average show very large divergences which, even if they were less than those of their parents, would still be very large. Of these selections only twelve of each kind, 'high' and 'low', actually grew, whilst actually the average oil-content of the seed of plants from 'high' seed was 49·3 per cent., and that of seed from 'low' seed was 50·6 per cent. Results such as these could not be expected to have occurred as a result of cross-fertilization, nor to have been due to mixed varieties, and it was assumed that the great differences, originally observed in oil-content in the seed of these varieties, may have been observed owing to the different conditions under which the plants were grown. At any rate it is obvious

that selection of seeds at random from different localities, in which the seed may have been grown under very different conditions, is not likely to be of much use.

Fresh selections were therefore made from the highest and lowest yielders of the 1919 crop. In this crop, the plots of which were grown under uniform conditions at Sabour, the differences between high and low yielders were not so great. Fifteen parents of low oil-content were taken, and twenty of high oil-content. Of the descendants of the fifteen 'low' plants only ten plots showed good growth. It would therefore be better to consider only these ten, as it is possible that this state of growth of the plant may have an effect on the oil-content of the seed. Nine of the twenty 'high' plots should probably also be eliminated, as they were badly affected by insect attack, and, in consequence, the flowers and seed were probably abnormal. In fact, the amount of seed produced was very small, and in every case showed an oil-content below the average. The mean of eleven good plots was 49·6 per cent. for descendants of parents whose mean was 54·2 per cent. The mean of the ten well-grown 'low' plots was 48·6 per cent. from parents whose mean was 42·5 per cent.

These results were found to differ very little from those obtained by taking the mean of all the plots, whether well or ill grown. In this case the mean of the twenty 'high' parents was 54·8 per cent. and of their descendants 47·8 per cent. The mean of the fifteen 'low' parents was 44·1 per cent. and of their descendants 47½ per cent. There appear, therefore, to be strong indications that in the majority of cases the plants do not transmit a high or low oil-content for even one generation, but that both 'high, and 'low' seeds give plants which, in nearly every case, give a seed near the mean oil-content, which lies somewhere close to 49 per cent. when the plants are healthy and a little lower when the reverse is the case. It will be seen, moreover, that the inclusion of the unhealthy plots has in each case, as was to be expected, lowered the mean oil-content of seed observed. Out of the whole series, however, two appear to have kept pure as regards high oil-content for more than one generation.

In connection with this interesting chemical selection, it is pointed out that variations occur between samples taken from a crop of a single strain. It is therefore necessary to determine the magnitude of these variations so as not to be misled. It was found that the probable error in the oil determination of a single sample of any one variety was about 1·0 per cent. of the weight of the seed.—AGRIC. NEWS, VOL. XXI, No. 516.

CURRENT PERIODICAL LITERATURE OF AGRICULTURE.

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H. LUDOWYK,
Librarian, Department of Agriculture.

MARKET REPORTS.

MARKET RATES FOR SOME TROPICAL PRODUCTS.

(FROM LEWIS & PEAT'S LATEST MONTHLY PRICES CURRENT).

GOODS	QUALITY	PRICE	PER	PKGS	POSITION	MARKET
BEANS AND PEAS						
Butter Beans ...	Madagascar New Crop..	£16 10/	ton	Bags	Spot U.K. ...	Steady
Rangoon Beans ...	Hand Picked ...	£7 5 to £7 10/	,,	,,	,, ,, ...	,,
Soya Beans ...	Manchuria ...	£12 10/	,,	,,	C.i.f. ,, ...	,,
COPRA—	Malabar ...	£26 15/	ton	Bags	C.i.f. U.K. ...	Steady
	Ceylon ...	£26 10/	,,	,,	,, ,, ...	,,
	Straits [F.M.S.] ...	£25	,,	,,	,, ,, ..	,,
COPRA CAKES—	Malabar ...	£10 to £10 10/	ton	Bags	C.i.f. U.K. ...	Small demand
	Ceylon ...	£9 to £10/	,,	,,	,, ,, ...	,, ,,
	Straits ...	£8 15/	,,	,,	,, ,, ...	,, ,,
GROUND NUTS—	Bombay Decorticated ...	£23	ton	Bags	C.i.f. Continent	Very firm
GROUND NUT CAKES—	Bombay 55% ..	£10 to £10 10/	ton	Bags	C.i.f. U.K. ..	Small demand
OILS—						
Palm Oil ..	Lagos ...	£37	ton	Casks	Spot U.K. ...	Firmer
	Congo ...	£32	,,	,,	,, ,, ...	,,
Coconut Oil ...	Cochin ...	42/6	cwt	,,	C.i.f U.K. ...	Steady
	Ceylon ...	40/	,,	,,	,, ,, ...	,,
PALM KERNELS—	West African ...	£18 10/	ton	Bags	Ex quay L'pool / Spot U.K.	Firmer
SEEDS—						
Castor Seed ...	Bombay ...	£16 10/	ton	Bags	C.i.f. U.K. ...	Steady
	Madras ...	£16	,,	,,	,, ,, ...	,,
Sesame Seed ...	Bombay ..	£22 10 to £23/	,,	,,	,, Continent...	Better. More demand

(From Perfumery and Essential Oil Record, Vol. 13. No. 4.)

GOODS	QUALITY	PRICE	PER	PKGS	POSITION	MARKET
Cinnamon Leaf Oil ...		5¾d.			Spot U.K. ...	Shown little movement
Do ...		4½d.			C.i.f. ,, ...	,, ,,
Cinnamon Bark Oil ...		48s. to 58s.	lb.			
Do ...	Genuine ...	7s.	oz.			
Citronella ...	Ceylon ...	1s. 11d. to 1s. 11½d.	lb.		Spot U.K.	
Do ..	,, ..	1s. 9½d.	,,		C.i.f. ,,	
Do ...	Java ..	2s. 11d. to 2s. 11½d.	,,		Spot ,,	
Do ...	,, ...	2s. 11d.	,,		C.i.f. ,,	
Do ...	Burmese ...	2s. 11d. to 2s. 11½d.	,,		Spot ,,	
Lemongrass Oil ...		2¾d.	oz.		,, ,,	Firmer
Do ..		2½d.	,,		C.i.f. ,,	,,

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 31st MAY, 1922.

Province, &c.	Disease.	No. of Cases up to date since Jan. 1st. 1922.	Fresh Cases	Recoveries.	Deaths.	Balance Ill.	No. Shot.
Western	Rinderpest	11	11	3	7	1	—
	Foot-and-mouth disease	200	67	151	1	48	—
	Anthrax	—	—	—	—	—	—
	Rabies	1	—	(1 destroyed)		—	—
	Hæmorrhagic Septicæmia	7	—	2	5	—	—
Colombo Municipality	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	122	—	—	—	—	—
	Anthrax	—	—	—	—	—	—
	Rabies	6	—	—	—	—	—
Cattle Quarantine Station	Rinderpest	12	—	—	—	—	—
	Foot-and-mouth disease	46	2	—	—	-	—
	Anthrax	116	27	—	—	—	—
Central	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	1	—	1	—	—	—
	Anthrax	6	—	—	6	—	—
	Piroplasmosis	7	1	7	—	—	—
Southern	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	6	—	6	—	—	—
	Anthrax	2	2	—	2	—	—
	Hæmorrhagic Septicæmia	37	—	4	33	—	—
	Black Quarter	3	3	1	2	—	—
Northern	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	294	—	294	—	—	—
	Anthrax	—	—	—	—	—	—
Eastern	Rinderpest		Nil				
	Foot-and-mouth disease						
	Anthrax						
North-Western	Rinderpest		Nil				
	Foot-and-mouth disease						
	Anthrax						
North-Central	Rinderpest		Nil				
	Foot-and-mouth disease						
	Anthrax						
Uva	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	186	56	161	2	23	—
	Anthrax	—	—	—	—	—	—
Sabaragamuwa	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	653	150	600	—	53	—
	Anthrax	—	—	—	—	—	—
	Hæmorrhagic Septicæmia	2	2	—	2	—	—

Colombo, 8th June, 1922.

G. W. STURGESS,
Government Veterinary Surgeon.

METEOROLOGICAL NOTES.

(Continued from next Column.)

The rain on the east side (which came largely in thunderstorms) occurred chiefly during this period of slight pressure differences and ceased in the last week of the month, as the gradient steepened and more definite monsoon conditions took charge on the western slopes.

Temperature offsets were all small and wind strength below average at Colombo, Puttalam and Trincomalee.

The amount of cloudy sky was slightly above average, and humidity rather below it in the low-country though about normal up-country.

A. J. BAMFORD,
Supdt. Observatory.

METEOROLOGICAL.

MAY, 1922.

Station	Temperature: Mean Daily Shade	Temperature: Difference from Average	Mean Humidity	Mean amount of cloud 0=clear. 10=overcast	Mean Wind Direction during month	Daily Mean Velocity.	Rainfall: Amount	Rainfall: No. of Rainy days	Rainfall: Difference from Average
	°	°	%			Miles.	Inches		Inches
Colombo Observatory	82·2	- 0·4	80	8·2	SW	142	22·66	26	+ 10·42
Puttalam	82·8	- 0·4	80	5·4	SSW	244	2·78	12	- 0·53
Mannar	85·5	- 0·3	76	6·2	SW	262	2·54	6	+ 0·48
Jaffna	85·1	- 0·1	76	5·5	SSW	399	0·88	6	- 0·90
Trincomalee	85·6	- 0·6	68	5·9	SW	221	6·27	9	+ 3·83
Batticaloa	84·2	- 0·4	76	3·8	ESE	141	6·25	11	+ 4·58
Hambantota	82·6	+ 0·4	80	4·9	SW	395	3·17	10	+ 0·03
Galle	81·2	- 0·7	82	6·5	WNW	276	14·91	21	+ 3·58
Ratnapura	81·7	- 0·1	81	7·1	—	—	12·47	25	- 5·46
Anu'pura	84·0	+ 0·5	72	6·0	—	—	0·75	5	- 2·62
Kurunegala	82·3	- 0·5	77	7·0	—	—	7·50	19	+ 1·10
Kandy	78·6	0	77	6·8	—	—	3·60	15	- 1·96
Badulla	75·3	- 0·7	80	6·2	—	—	2·39	11	- 2·09
Diyatalawa	70·6	0	74	5·8	—	—	3·04	12	- 1·92
Hakgala	63·6	0	82	6·4	—	—	4·61	16	- 2·35
N. Eliya	62·0	+ 0·3	82	8·2	—	—	4·56	20	- 2·19

The rainfall for the month was in deficit throughout two-thirds of the island. The area in which deficits were over two inches included practically all the Central Province, and extended northward to Dambulla and Anuradhapura, westward to Veyangoda, and included most of the southern halves of Sabaragamuwa and Uva. Only one or two stations were as much as 5 in. below average and these included Ratnapura, Gourakele and Denagama.

On the other hand the average was passed in nearly all the coastal areas. On the west offsets of over 2 in. were found from North of Puttalam to Matara and as far inland as Rayigama and Hiniduma. Offsets of over 5 in. were found from Colombo to Maggona and at slightly inland stations further south (e.g. Elpitiya, Hiyare) and in several cases offsets of over 10 in. occurred. On the East coast the average was passed from Mullaittivu to Sakamam (23 miles South of Kalmunai) offsets of over 5 in. occurring at Rugam, Unichchai and Amparai.

Areas in which the average was just reached, but without large offsests, included northern Sabaragamuwa parts of the North Western Province and Uva, the eastern half of the Jaffna peninsular, Mannar and Hambantota.

As regards distribution in time, the first week of the month was rather dry throughout; but from the 8th to the 20th, there was consistent rain particularly from the 8th to the 14th over the coastal strips referred to above, though there was a conspicuous shortage of rain up-country on these dates. From the 20th to 26th there was again not much rain but from the 26th onwards the South West quarter of the island received a fair amount though not enough to bring the up-country stations up to their average for the month.

The connection between these variations and the development of the monsoon gradient is interesting and notably so in the case of the heavy rain in the lowcountry. In the five days ending on 13th, Colombo Observatory registered 14·88 inches, Kalutara 14·03 and Bandaragama 15·82. This naturally raised the usual monsoon queries, but during those days the gradient of pressure was not particularly steep and this fact taken in conjunction with the comparatively low rainfall at stations on the south-west face of the hills suggests that it was this very slackness of gradient that was responsible for the heavy rain on the west coast, since it allowed the clouds to be checked there by local air circulations instead of being forced onwards to the more solid opposition of the hills.